MODERN PLASTICS

JANUARY 1959

REVIEW OF 1958—PROSPECTS FOR 1959

Shift one of America's heaviest passenger cars into reverse—and this little ring transmits full engine power to the rear wheels! The ring is molded of Durez 16771 by Smithway Plastics, New Hudson, Mich.; Michigan Panelyte Division, St. Regis Paper Company, Dexter, Mich.; and Modern Plastics Corp., Benton Harbor, Mich.

New super-phenolic makes parts that can outwear metal!

Do you need *toughness*, along with all the other values a good plastic can give you?

Take a look at *Durez 16771*, the new super-phenolic that's reinforced with fibrous glass.

Engineers picked this material for the ring-shaped clutch cone in the automatic transmissions of three major automobiles.

When the transmission is shifted to reverse, this 3½-ounce plastic cone transmits full engine power to move a 2¾-ton car!

Look what else this Durez phenolic does for the car manufacturers: it outlasts the material previously used . . . easily resists high transmission temperatures . . . remains dimensionally stable under all operating conditions . . . eliminates the tendency to gall, or roll up, which would cause reduced clearances.

In addition, it cuts manufacturing cost because hardly any finishing is needed. The part comes out of the mold, just as you see it here, to highly accurate tolerances.

Durez 16771 is formulated for high chemical resistance; withstands oil, water, mild acids and alkalies. Typical molded parts have an Izod impact strength up to 15 ft.-lb./in. It stands heat up to 600°F without distortion.

Your custom molder knows about *16771* and can help you put it to work. To explore how you can use it to get a better-functioning product, or reduce manufacturing costs, check with your molder now. Or, for more information, write for our *new Technical Bulletin on Durez 16771*, just off the press.

DUREZ® HOOKER CHEMICALS PLASTICS

PLASTICS DIVISION

HOOKER CHEMICAL CORPORATION

1201 Walck Road, North Tonawanda, N. Y.

It's high time... to plan with *Catalin* STYRENE

However satisfying Christmas 1958 was for you—and we hope it brought you a wealth of good things—it is *already* time for you to start planning your new packaging and product ideas for Christmas 1959 . . . so that mold-making, production and marketing operations can be coordinated well in advance, to arrive at the holiday market with the utmost in customer-appeal.

In an industry long recognized for its packaging excellence, Trim-a-Tree*—shown above, molded of general-purpose CATALIN STYRENE, represents an entirely new concept in watch packaging. Designed by Bulova to pinpoint and enlarge its sales potential during the important Christmas season, it ingeniously fulfilled every requirement of its responsibilities . . . as a custodian of Bulova's prestige and quality . . . as a point-of-sale display . . . as a handsome gift package . . . and as a decorative tree ornament.

For the most effective packaging of your own product in 1959, weigh well the unsurpassed qualities offered you by CATALIN STYRENE, in general-purpose, impact or heat-resistant grades . . . by CATALIN POLYETHYLENE, in the widest range of densities and melt indexes . . . and by CATALIN NYLON, in extrusion, injection or blow molding grades. Inquiries invited.

**Trim-a-Tree was designed by Bulova Watch Co., developed and produced by Shields, Inc., New York, N. Y.*

Catalin Corporation of America Catalin **One Park Avenue, New York 16, N. Y.**

MODERN*

The Cover

Against a cracking plant in the background stands a laboratory flask in which a petroleum resin is being extracted as part of an analytical procedure. Color photo courtesy of Consolidated Electrodynamics Corp., Pasadena, Calif., by staff photographer Robert Humphreys.

The Plastiscope

General-purpose vinyl reduced to 23½¢ per pound (p. 39); Miami Beach specifies rigid PVC for conduits (p. 39); new styrene-methyl methacrylate copolymer announced (p. 43); winners of Informative Labeling Contest (p. 204).

Editorial

General Section

Consumption of plastics and synthetic resins increased slightly in 1958 over 1957, largely because of increases of 160-million-lb. in polyethylene, 40 million lb. in polyesters, and 20 million in polystyrene. All others declined. PVC held almost even, but declined considerably in almost every class except floor covering, which gained 30 million. This article gives detailed analysis of the record.

Markets for plastics continue to develop and expand on a larger scale in polyethylene and vinyl chloride than for any other material. Other thermoplastics, too, continue to expand in smaller volume. But thermosetting materials are at a standstill. The billion-lb.-a-year mark for several thermoplastics is not too far in the future. Here is the story, material by material.

Established early in 1958 to stimulate and encourage the imaginative employment of plastics materials, the Bachner Award Competition announced its first winners at the recent Plastics Show in Chicago. Presented here are complete details about the winning entries, reasons why they were chosen.

A team of MPl editors covered the recent Plastics Exposition and Conference in Chicago. This is their report. It covers machinery, materials, and application. It also provides an interpretation of the Show in terms of trends discernible from an examination of the booths of over 200 exhibitors.

Modern Plastics Executive and Editorial Offices: 575 Madison Avenue, New York 22, N.Y.
Please mail all correspondence, change of address notices, subscription orders, etc., to above address

Modern Plastics issued monthly, except September when issued semi-monthly, by Breskin Publications, Inc. and Plastics Catalogue Corp., at Emmett St., Bristol, Conn. Second-class postage paid at Bristol, Conn. Subscription rates (including Modern Plastics Encyclopedia Issue), payable in U. S. currency: In United States, its possessions, and Canada 1 year $7, 2 years $12, 3 years $17; all other countries, 1 year $25, 2 years $45, 3 years $60. Single copies 75¢ each (Show issue, $1.00; Encyclopedia issue, $3.00) in the U. S., its possessions, and Canada; all other countries $2.50 (Show issue, $3.00; Encyclopedia issue $6.00). *Reg. U.S. Pat. Off

PLASTICS*

JANUARY 1959
Volume 36 Number 5

Reported in this article is the work done by Technical Committee 61 on Plastics of the International Standardization Organization at its recent meeting. Must reading for those concerned with standards.

• Plastics Engineering

In the face of a general recession in the hard goods industries, processing machinery makers have shipped almost as many machines as they did in 1956 and 1957.

In the past our figures on machines shipped have been consistently high because of an almost universal tendency to overestimate the last quarter. Also, our cumulative figures have not taken into account machine retirement. Here are corrected figures for the entire 18-year survey.

• Technical Section

Over 800 literature references provide a definitive picture of technical work in plastics in 1958 on graft copolymers, radiation, materials, processing, applications, properties, and standards.

• Departments

Coming up

Our February issue will emphasize new developments and applications of reinforced plastics. Lead article will present the complete story of a new and most automatic reinforced plastics processing plant for manufacturing outboard motor components. Also in February will be offered the third article in our series on polyethylene, covering pipe and other extrusions. And complete engineering coverage of the best recommended methods for molding, extruding, and forming polypropylene. . . . Lead article in March will be the first of a series covering the urethanes in all their aspects—foams, coatings, adhesives, etc. In March also the fabulous story of the Pan American Airways travel bag molded of high-density polyethylene—a market that is probably bigger than the Hula hoop. . . . And the first of three articles on problems in pre-mix molding and how to overcome them. A feature on slush molded blends of low molecular weight and high molecular weight polyethylene to make toys, juice containers and other items. . . . In April our lead feature article will be concerned with the latest developments in methods of decorating molded plastics.

Printed in U.S.A. by Hildreth Press, Inc., Bristol, Conn. Member, Audit Bureau of Circulations. Member, Associated Business Publications. Modern Plastics is regularly indexed in the Applied Science & Technology Index and Industex

This attractive seed-starter kit, which retails at an economical 49¢, needs only to have holes punched and water added for germinating the seeds. Lid made from Campco stress-free acetate and base from Campco S-300.

Perfect pack for the product ...with low-cost CAMPCO sheet

Low production cost is the big requirement for this Northrup-King Punch'n Gro pack. Yet other requirements are equally stringent. The hole recesses must be easy to punch out, but not so weak that they will rupture in shipment. The lid also should have high optical clarity, yet cannot shatter or crack during shaping. The base, too, needs to have high impact resistance, even in sections thinned for economy.

Here's how Campco know-how and materials met the requirements:

1. CAMPCO acetate provided the crystal clarity needed in the lid. Its special non-blushing formulation eliminates all clouding and discoloration.

2. To achieve high impact strength in the base, CAMPCO provides rubber-modified polystyrene sheets (.015" gauge) which are vacuum-formed to make the base—permitting a much thinner gauge than injection-molding, since it eliminates internal stresses. In the lid, this permits using .010" gauge acetate—necessary for punching of clean holes—because fragility is eliminated.

3. To meet the required production cost, CAMPCO worked closely with Mankato Paper Box Company, the package manufacturer—providing technical assistance which aided Mankato in producing the Punch'n Gro seed pack economically.

Here's how Campco can help you

CAMPCO's complete line of thermoplastic sheet and film fulfills all of your requirements—acetate, butyrate, rigid and flexible polyethylene, rubber modified styrene and copolymer styrene (A.B.S.) and nylon. Also CAMPCO's Registrite which is made especially for applications where high-quality printing and registration are required. CAMPCO can suggest design methods—to take advantage of economical stock rolls and sheets—and also suggest sources of fabrication in your area. All CAMPCO sheets are available in a wide variety of sizes, gauges and colors. For complete details, write today:

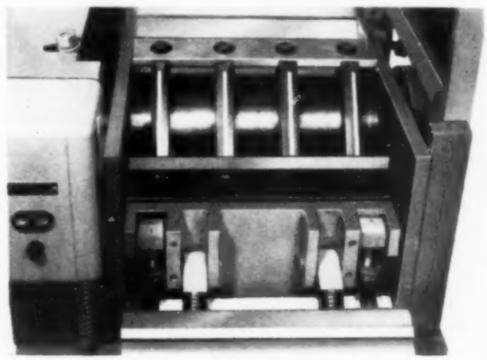
CAMPCO *sheet and film*

a division of **Chicago Molded Products Corp.**

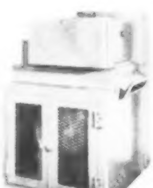
2708 Normandy Avenue, Chicago 35, Illinois

STYRENE • ACETATE • POLYETHYLENE • RIGID POLYETHYLENE • BUTYRATE • COPOLYMER STYRENE • NYLON

FIVE NEW
Cumberland
Large Throat
GRANULATING MACHINES

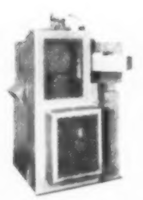


PART OF THE COMPLETE LINE OF CUMBERLAND PELLETIZERS, BESIDE THE PRESS AND CENTRAL GRANULATING MACHINES, DICERS, CHOPPERS AND PRE-BREAKERS



CUMBERLAND PELLETIZING MACHINE

New feed roll mechanism provides better control of extruded strands of plastic materials. Cuts cubes or pellets 1/32" to 1/2". 14" and 24" openings.



STAIR STEP DICER

Produces perfect cubes or pellets 1/16" to 1". Two standard sizes accommodate up to 7" and up to 14" ribbons.

LARGE THROAT OPENINGS — 12" x 16" (Shown above). Also 7" x 10", 8½" x 12", 8½" x 16", 12" x 20".

QUALITY CONSTRUCTED entirely of steel weldments. Advanced design leaves all working parts readily accessible for cleaning and adjustment of knives.

NEW PERFORMANCE — New knife design and slow rotor rpm provide better granulation and quiet operation. Clean cutting of the complete range of thermoplastic materials from softest polyethylene and vinyls to hard and tough nylon, Cycolac, and Kralastic.

MINIMUM FLOOR AREA — Desirably compact for central and beside the press applications.

Write now for literature

DEPT. 1 · BOX 216, PROVIDENCE 1, RHODE ISLAND

Direct factory engineering assistance available throughout North America from sales offices in Providence, New York, Cleveland, Chicago and Los Angeles

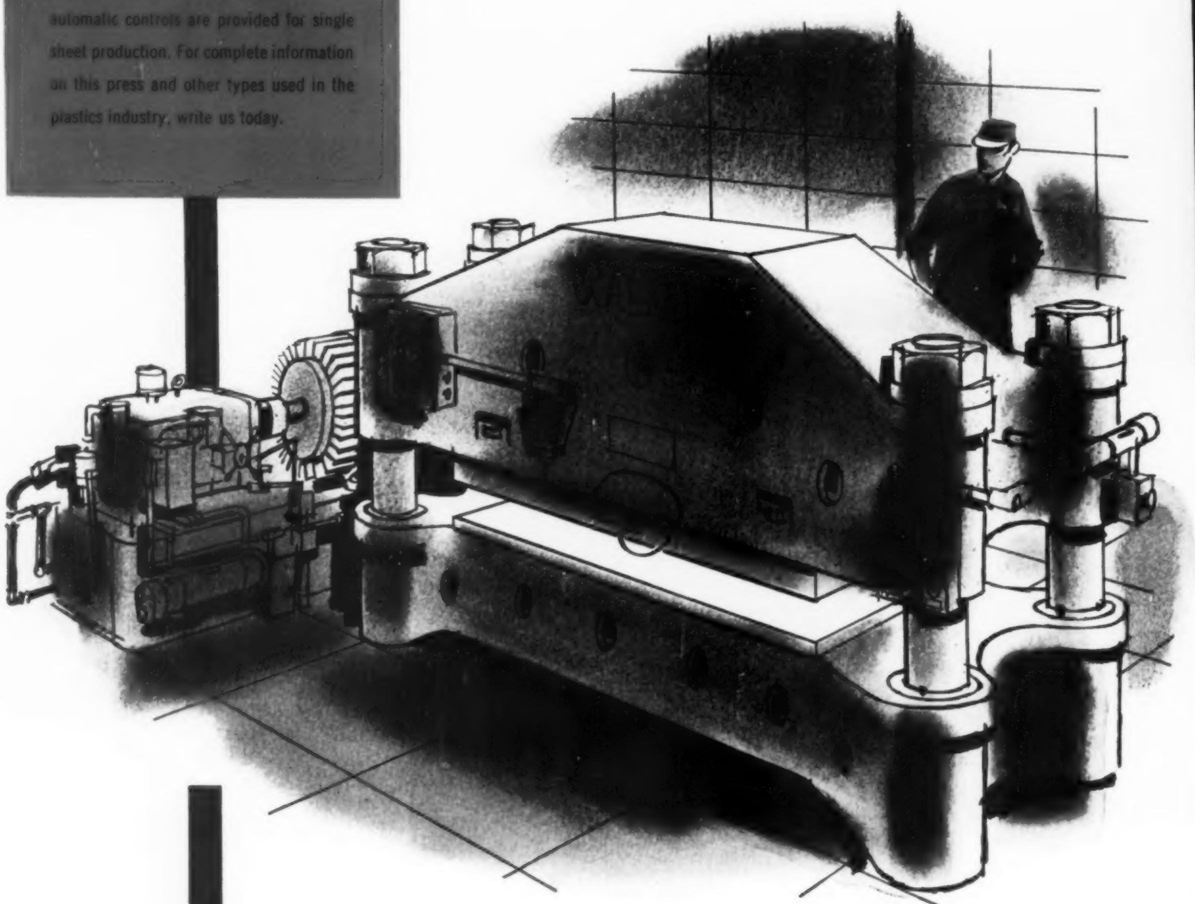
FOREIGN LICENSEE — BURTONWOOD ENGINEERING COMPANY, LTD.
Burtonwood, Warrington, Lancashire, England
Sole Manufacturers and Distributors outside North and South America

Cumberland
ENGINEERING COMPANY, INC.

Single Opening 500-ton Embossing Press for use on leather and plastic products. Fully automatic operation with suitable feeding mechanism permits pressing of sheets at rate of 12 cycles per minute. Semi-automatic controls are provided for single sheet production. For complete information on this press and other types used in the plastics industry, write us today.

Success is seldom accidental

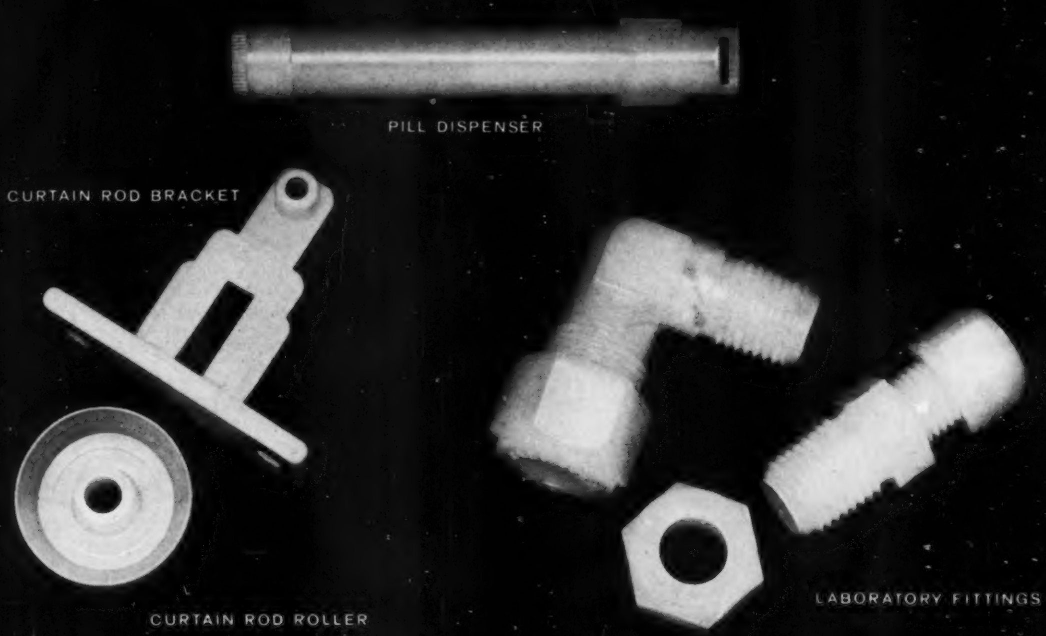
People and products do stumble into success. But not often. The success of R. D. Wood Presses, for example, stems from unremitting attention to details. Every R. D. Wood Press is the product of sound design, carefully chosen materials, conscientious workmanship. This is why R. D. Wood Presses consistently deliver the utmost in smooth, dependable performance; fast, economical production; and trouble-free operation. And this is why so many leading press-users specify R. D. Wood.



R. D. WOOD COMPANY

PUBLIC LEDGER BUILDING • PHILADELPHIA 5, PENNSYLVANIA

DESIGNED IN CELANESE FORTIFLEX...



from Laboratory Fittings to Pill Dispensers . . .
Product improvement inspired by FORTIFLEX

These applications of the remarkable new Celanese polyolefin plastic Fortiflex are typical of dozens—hundreds—of industrial products and components that are already being made of this material . . . and the list of new products and design improvements inspired by Fortiflex is growing daily. For Fortiflex possesses many of the desirable features of polyethylene . . . *plus* new rigidity, new strength, new surface lustre. It's resistant to acids and alkalis, heat and cold; it's structurally strong; and it's economically molded. Fortiflex is presently available in four melt indexes developed to accommodate a wide range of conditions and applications of interest to designers and manufacturers. For more information and/or test quantities, please use the coupon.

Celanese® Fortiflex®

TYPICAL PHYSICAL AND CHEMICAL PROPERTIES OF FORTIFLEX

Properties of Fortiflex "A" Related to Melt Index

PHYSICAL PROPERTIES	ASTM METHOD	UNITS	FORTIFLEX RESINS A-20	A-70	A-250	A-500
Melt Index	D-1238-52T	—	0.2	0.7	2.5	5.0
Heat Distortion Temp. (66 psi)	D-648-45T	°F.	185	185	180	180
Brittleness Temp.	D-764-52T	°F.	—200	—180	—160	—100
Impact Strength, izod (⅛" x ½" injection-molded bars)	D-256-54T	ft. lb./in. notch	23	18	13	3
Tensile Strength, Max., 0.2 in./min.	D-638-52T	ps	3700	3600	3500	3300
Elongation, First Tensile Yield Point	D-638-52T	%	25	25	25	25

Proeerties of Fortiflex "A" Not Affected by Melt Index

PHYSICAL PROPERTIES	ASTM METHOD	UNITS	VALUE
Density		g/cc.	0.96
Refractive Index	D-542-50	n_D^{25}	1.54
Hardness, Shore D	D-676-49 T		65
Stiffness	D-747-50	psi	150,000
Water Absorption (⅛" specimen, 24 hr. immersion @ room temp.)	D-570-54T	%, wgt. gain	<0.01
Flammability	D-635-44	in./min.	1.0
*Mold Shrinkage length		in./in.	0.03 to 0.05
width		in./in.	0.02 to 0.04

*Measured on injection molded tensile bar. Mold shrinkage depends on part design and molding conditions

Fortiflex...a Celanese plastic

Canadian Affiliate: Canadian Chemical Company Limited, Montreal, Toronto, Vancouver.
Export Sales: Amcel Co., Inc., and Pan Amcel Co., Inc., 180 Madison Avenue, N. Y. 16

Celanese Corporation of America, Plastics Division,
Dept. 101-A, 744 Broad Street, Newark 2, N. J.

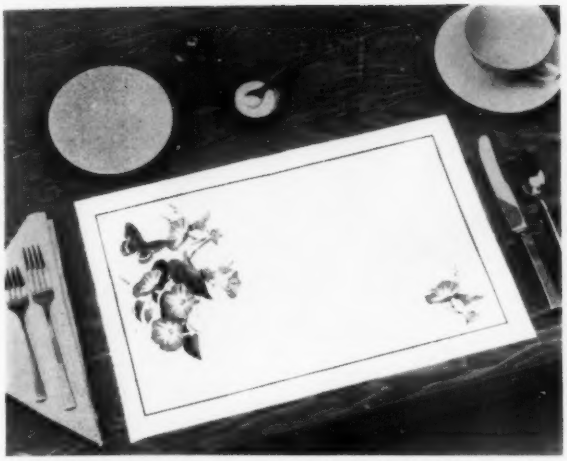
Please send: ☐ more information on, ☐ test quantities of Fortiflex.

Name__________ Title__________

Company__________

Address__________

City__________ State__________



ATTRACTIVE PLACE MATS are made by laminating various illustrations and patterns between two sheets of ALATHON polyethylene resin. Durable and flexible, the colorful place mats are reversible . . . and can be easily cleaned with a damp cloth. (Manufactured by Hedwin Corporation, Baltimore 11, Maryland.)

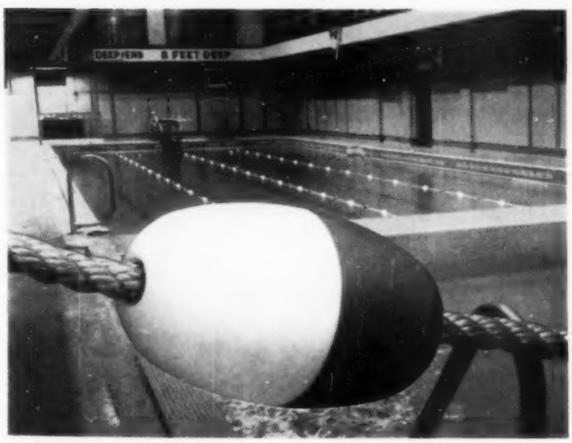
REAGENT DISPENSER of ALATHON 37 polyethylene resin is outstanding example of a pump made entirely of polyethylene and used for corrosive liquids . . . in this case, laboratory chemicals. The unbreakable dispenser is light, compact, and easily cleaned. (Manufactured by Pioneer Plastics, Dayton, Ohio.)

Du Pont ALATHON® polyethylene resin tailored for your needs

Shown here are a few examples of how the family of Du Pont ALATHON polyethylene resins is being successfully applied to a variety of products.

In each of the many members of this versatile family, the molecular structure has been carefully controlled to develop a resin which excels in certain properties. Thus there is an ALATHON tailored to give the best possible results . . . whether your product is extruded, molded or coated.

Fill in and mail the coupon for additional information and assistance in selecting the proper ALATHON polyethylene resin for your needs.



FLOATS molded of ALATHON 14 polyethylene resin are used as swimming-pool markers and as a "bobber" on commercial fishing nets. Larger-size floats serve as buoys for marking channels. Strong and long-lasting, the floats are economically manufactured and easily colored. (Molded by Rainbow Plastics Co., El Monte, Calif.)

POLYCHEMICALS DEPARTMENT

DU PONT

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Dept.
Rm. A-29-1, Du Pont Building, Wilmington 98, Delaware

Please send me more information on Du Pont ALATHON polyethylene resins. I am interested in evaluating these materials for________

Name________
Company________ Position________
Street________
City________ State________
Type of Business________

IN CANADA: Du Pont of Canada Limited, P. O. Box 660, Montreal, Quebec.

NEW...REED J

high-speed injection molding machine fr

These revolutionary advantages are found only in the JETFLO

1.3 second dry cycle

Through its more efficient, faster plasticizing and lower molding temperature, the JETFLO offers this unusually fast dry cycle. In actual production runs the JETFLO has molded thin-wall (.012) cups at a 1.7 second molding cycle. During such full automatic operation a low pressure die closing system affords complete, positive mold protection.

Higher, more uniform product quality

This is a direct result of JETFLO plasticizing which features a hollow screw with an actuating plunger in its hollow bore. The REED JETFLO with the continuous mulling action of the screw, lower injection pressure, limited plasticizing area and lower, even heating of virgin material gives a consistently high product quality and far greater uniformity than any machine available today.

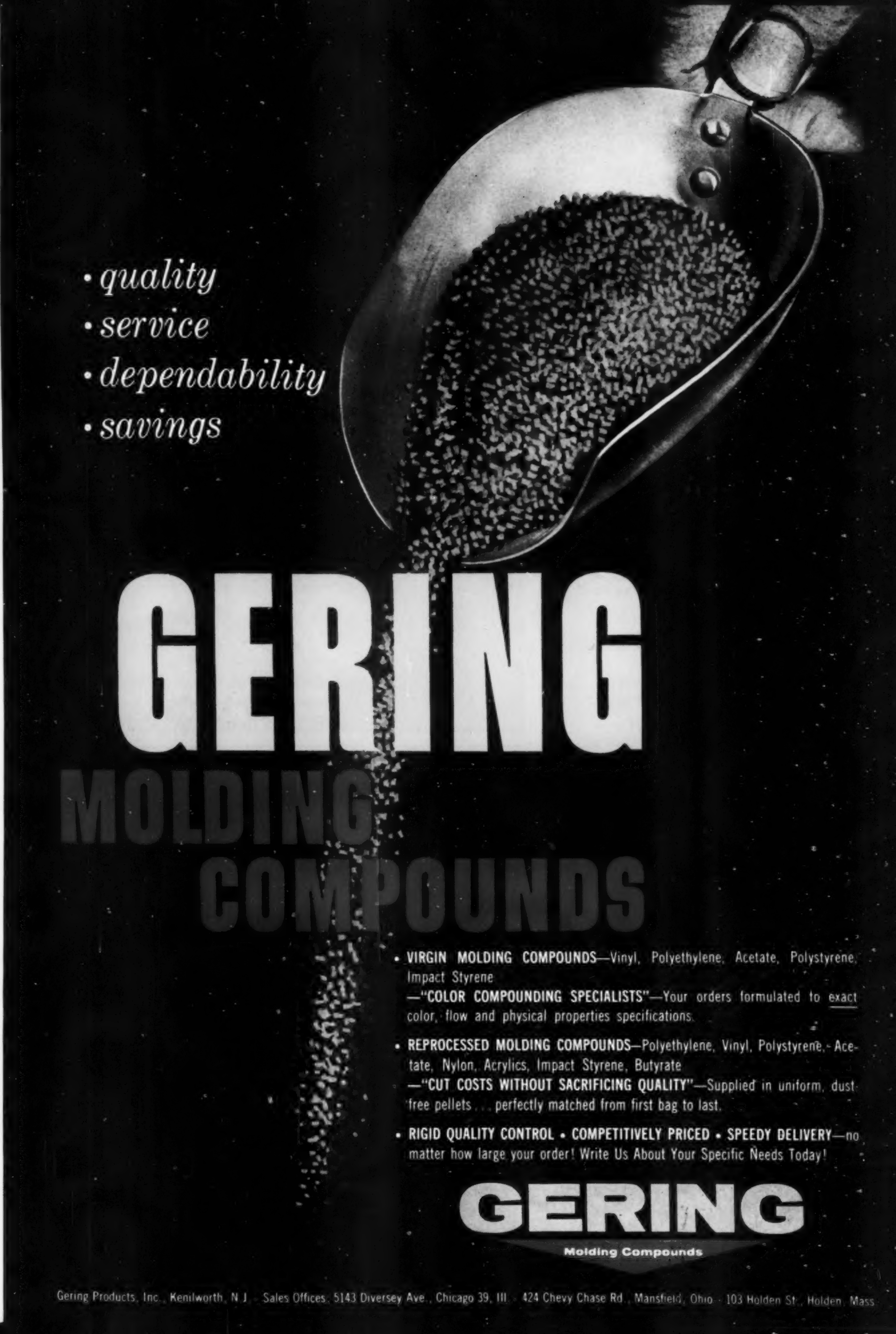
Dry coloring without premixing

Never before have you been able to obtain such complete, uniform color blending without time consuming premixing. Dry color is put directly into the hopper with the material being used. The continuous moving and compounding throughout the length of the screw and against the heated cone baffle results in complete color dispersion, uniform product coloring and elimination of flow lines.

Proved savings in material costs

The REED JETFLO, with its quick and easy color blending, also provides you with the means to substantially reduce your material costs. By using the JETFLO dry coloring method you get fast, easy changing of colors and you eliminate buying the raw material already mixed or the need for extensive premixing, as is the case in ordinary molding machines.

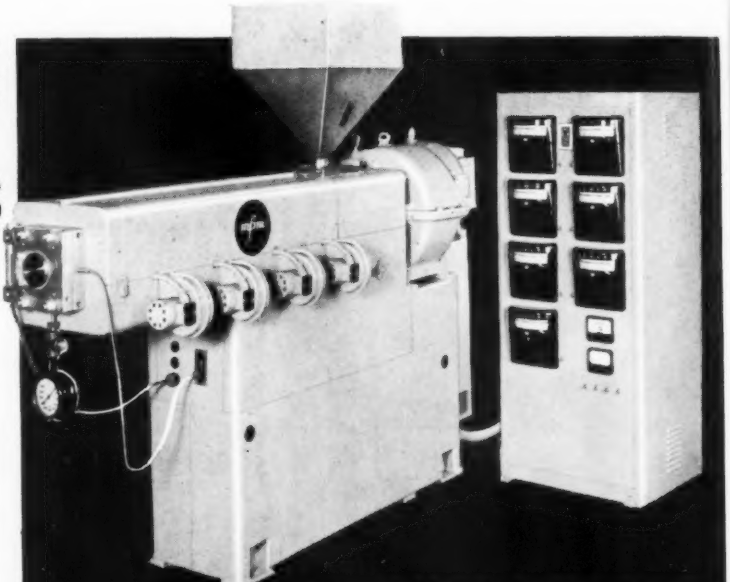
The REED JETFLO *proves that you can mold faster . . . improve product quality . . . obtain quick, easy color blending . . . and most important save time and money. Contact your nearest* REED *Sales Engineer for complete details and specifications.*



• quality
• service
• dependability
• savings
GERING
MOLDING
COMPOUNDS
• VIRGIN MOLDING COMPOUNDS—Vinyl, Polyethylene, Acetate, Polystyrene, Impact Styrene
—"COLOR COMPOUNDING SPECIALISTS"—Your orders formulated to exact color, flow and physical properties specifications.
• REPROCESSED MOLDING COMPOUNDS—Polyethylene, Vinyl, Polystyrene, Acetate, Nylon, Acrylics, Impact Styrene, Butyrate
—"CUT COSTS WITHOUT SACRIFICING QUALITY"—Supplied in uniform, dust-free pellets . . . perfectly matched from first bag to last.
• RIGID QUALITY CONTROL • COMPETITIVELY PRICED • SPEEDY DELIVERY—no matter how large your order! Write Us About Your Specific Needs Today!
GERING
Molding Compounds
Gering Products, Inc., Kenilworth, N.J. · Sales Offices: 5143 Diversey Ave., Chicago 39, Ill. · 424 Chevy Chase Rd., Mansfield, Ohio · 103 Holden St., Holden, Mass.

LOOK AT THE OTHERS ...BUT BUY THE BEST!

MPM's sensational new "Century Series" Extruders available in Standard, Hi-Speed and Vented models with screw sizes from 1" to 8".



MPM AIR-COOLED PLASTIC EXTRUDER
Model No. EF-250-20

15 PROFITABLE REASONS WHY YOU SHOULD

Buy mpm

1. "Cast-In" Heaters (Induction or Band available).
2. Uniform heat control.
3. Complete control cabinets wired to J.I.C. codes*.
4. One-piece air-cooled cylinders.
5. Xaloy liners in all sizes — 1" to 8".
6. High-thrust bearing capacity.
7. Long bearing life at high (10,000 psi) working pressure.
8. True bearing ratings.
9. Over-size herringbone gear transmissions in 2"-8" sizes.
10. Matched dies, takeups, and accessories.
11. Complete packages fully wired for low cost installation.
12. Screw speed Tachometer — Motor Load Indicator.
13. 16:1—20:1—24:1 Length/Diameter ratio cylinders. (Measured from front of feed opening) (Other lengths on request)
14. Heavy duty construction throughout.
15. Quick opening covers for easy accessibility of all parts.

**Joint Industrial Council.*

100% COMPLETE PACKAGED UNITS WITH ALL ACCESSORIES

MPM Extruders are available in screw sizes of 1" — 1½-2" — 2½" — 3½" — 4½" — 6" — 8" with cylinders of 13.1 — 16:1 — 20:1 — 24:1 — LE/D Ratio — with or without vents

MPM Model No.	ESF-100-12 EF-100-12	EF-250-20	EF-350-20
Screw Diameter	1"	2½"	3½"
Le/D Ratio	12:1	20:1	20:1
Heating Load—Watts	1800	12,750	25,000
Heating Zones	2	4	4
Gear Ratio (Standard)	20:1	23.8:1	24.9:1
Transmission HP at 75 RPM	.45	28	37
Type Gears	Worm	Herringbone	Herringbone
Thrust Bearing Capacity Dynamic Load Rating	11,750#	215,000#	400,000#
B-10 Life at 75 rpm	4,000 hrs. at 5,000 psi 32,000 hrs. at 2,500 psi	27,000 hrs. at 10,000 psi 216,000 hrs. at 5,000 psi	25,200 hrs. at 10,000 psi 201,600 hrs. at 5,000 psi
Motor HP	.5	15 - 25	25 - 30
Screw Speed (Standard)	8-80 rpm	7-85 rpm	7-85 rpm
Output per hour	6-12 lbs	85-135 lbs.	200-250 lbs.
Cooling System—Cylinder	None	Air	Air
Cooling System—Hopper	Water	Water	Water

Note: B-10 Life —
See Anti-Friction Bearing Mfg. Assoc. Stds. Specifications for other size Extruders on request.

modern plastic machinery corp.
15 Union St., Lodi, N. J., U. S. A. • Cable Address: MODPLASEX
IN USE IN THE UNITED STATES AND THROUGHOUT THE WORLD

TEN bright colors for

INDUSTRIAL FINISHES

PLASTICS

BLEED-PROOF BLEED-PROOF BLEED-PROOF BLEED-PROOF

Exceptionally Heat Stable
Excellent Permanence
Exceedingly Easy to Disperse

HARSHAW

CADMIUM RED PIGMENTS

Cadmium Lithopones
- ORANGE RED No. 70
- LIGHT RED No. 80
- MEDIUM LIGHT RED No. 90
- MEDIUM RED No. 100
- DARK RED No. 110
- MAROON No. 120

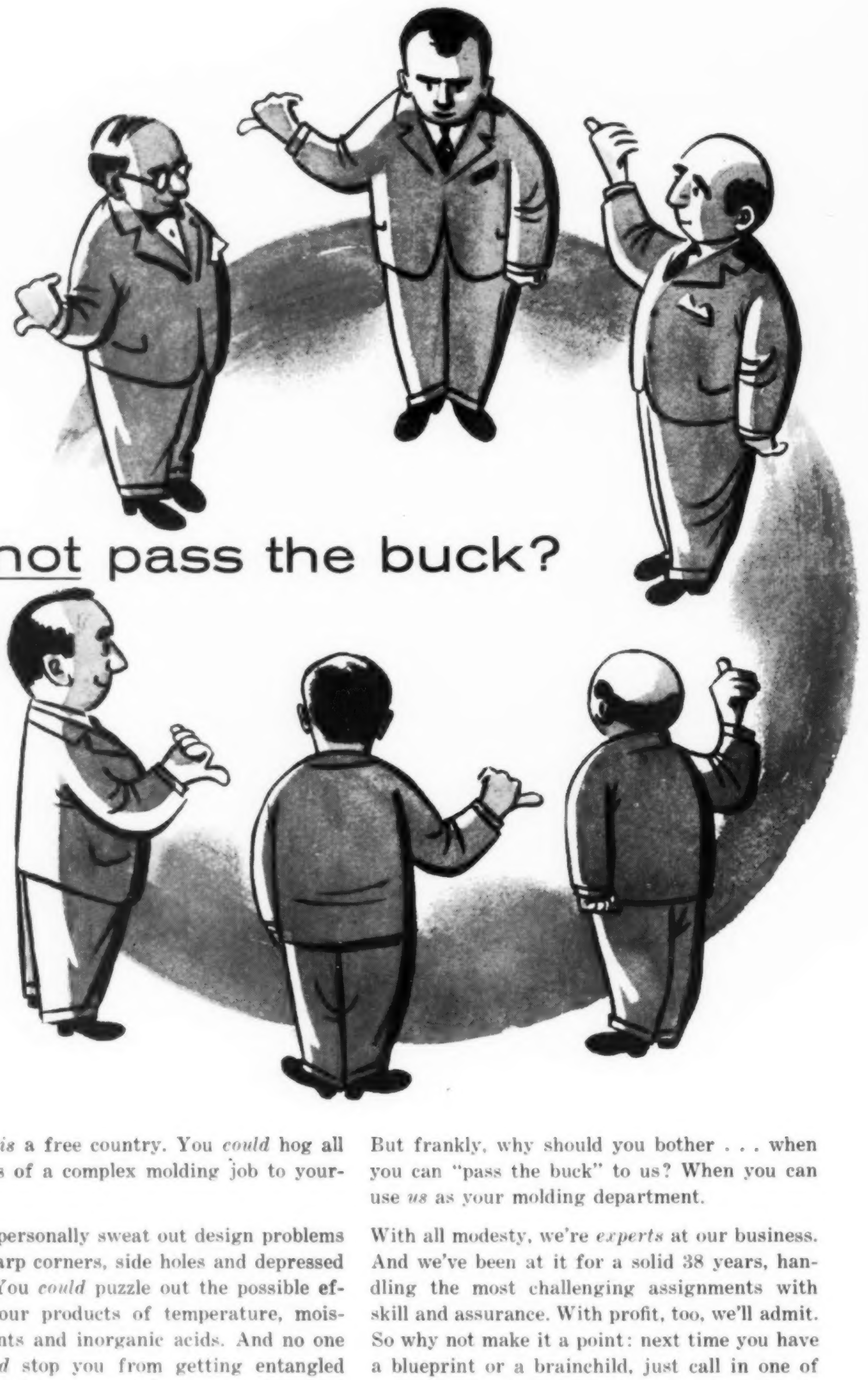
CADMIUM YELLOW PIGMENTS

Cadmium Lithopones
- PRIMROSE No. 20
- LEMON No. 30
- GOLDEN No. 40
- ORANGE No. 50

SAMPLES and COLOR FOLDER showing full range of Yellows and Reds, CP and Lithopone will be gladly furnished on request.

The Harshaw Chemical Co.
Cleveland 6, Ohio

Chicago • Cincinnati • Cleveland • Detroit • Hastings-On-Hudson • Houston • Los Angeles • Philadelphia • Pittsburgh



Why not pass the buck?

Sure, this *is* a free country. You *could* hog all the worries of a complex molding job to yourself.

You *could* personally sweat out design problems such as sharp corners, side holes and depressed lettering. You *could* puzzle out the possible effects on your products of temperature, moisture, solvents and inorganic acids. And no one really *could* stop you from getting entangled with production, assembly, inspection and packaging for delivery.

But frankly, why should you bother . . . when you can "pass the buck" to us? When you can use *us* as your molding department.

With all modesty, we're *experts* at our business. And we've been at it for a solid 38 years, handling the most challenging assignments with skill and assurance. With profit, too, we'll admit. So why not make it a point: next time you have a blueprint or a brainchild, just call in one of our representatives. He'll be more than glad to "pass" you some friendly advice.

BOONTON MOLDING CO.
BOONTON, NEW JERSEY

New York Metropolitan Area—Cortlandt 7-0003
Western New York Area—Alden 7134
Connecticut Area—Woodbine 1-2109 (Tuckahoe, N. Y.)
Philadelphia Area—Pioneer 3-0315

these thermatic Series* extruder features mean higher production on every job!

Simplified one piece cylinder with integrally cast-in Xalloy liner.

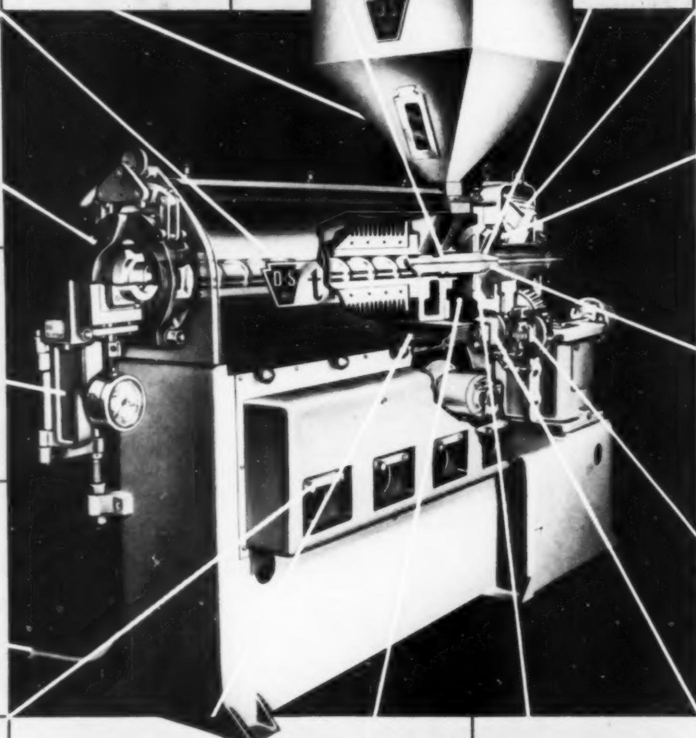
Extra large capacity stainless steel hoppers.

Screw flight extends back beyond the feed throat opening for improved powder and granule feeding.

Four-spline screw drive eliminates the eccentric screw rotation of a single key drive.

Helical gearing — smooth, efficient, free-running. Greatly increased horse-power capacity.

New stronger head clamp. Simplified opening and closing of head with positive safety shear pin arrangement.



Higher thrust bearing capacity. Extra-heavy separate thrust and radial bearings handle their respective loads individually to meet constantly increasing production requirements.

Improved hinged head support swings completely clear of the front of the extruder.

Tapered drive end of stock screw positively centers screw and simplifies removal.

Heaters and controllers completely wired for fast inexpensive installation.

Gear type oil pump, positively driven from input shaft, lubricates all bearings and gears regardless of speed.

Damper arrangement provides several gradients of natural draft cooling. Blowers provide high circulation for stubborn cooling jobs.

Air-tight oven effect adjustment by new second set of dampers for high temperature extrusion.

Access opening allows easy replacement of bronze feed throat bushing.

Labyrinth oil seals — simple non-wearing design. No oil seals or rings to replace.

Built-in direct drive stock screw electric tachometer.

Greater cylinder lengths standard on all extruder sizes with optional L/D ratios available. **2½", 3½", 4½", 6" and 8" models available.** The New D-S thermatic Series Extruders will outproduce — size for size — any other extruder on the market today. For complete specifications and details write to:

DAVIS - STANDARD

Division of FRANKLIN RESEARCH CORPORATION

16 WATER STREET, MYSTIC, CONNECTICUT

*Patented

In Canada contact E. V. Larson Co. Ltd., 572 Queen St. East, Toronto 2, Ontario/in Europe and the Sterling Area contact Fawcett, Preston & Co. Ltd., Bromborough, England/in Chicago contact C. J. Beringer Co., 5522 Milwaukee Ave., Chicago, Illinois.

eg PLENCO ELECTRICAL GRADE PHENOLIC COMPOUND

PLENCO 343 MICA PHENOLIC MOLDING COMPOUND

For Low-Loss Insulation Applications and Where Very Low Power-Factor is Required.

Available in STANDARD GRANULATIONS and also particle sizes best for AUTOMATIC MOLDING MACHINES; both granulations in

NATURAL, RED, and BLACK COLORS

Besides theoretical considerations in designing this compound, we have paid particular attention to such practical considerations as:

PREFORMABILITY. To obtain uniform density and subsequent uniform dielectric preheat.

LUBRICATION. To reduce mold-sticking and fouling without impairing electrical qualities.

RESIN CHARACTERISTICS. Relating to molecular weight-viscosity and set-time to provide dense, non-porous moldings absolutely essential for high standards of reliability.

Our technical staff is prepared to consult with you at any time about this electrical grade compound or any other molding material or problem.

Plenco 343 Mica Phenolic Compound is packed only in moisture-proof drums.

IF PHENOLICS CAN DO IT—

plenco CAN PROVIDE IT . . .

already-made or specially-made

PLENCO PHENOLICS
FOR BETTER PLASTIC PRODUCTS

PLASTICS ENGINEERING COMPANY

Sheboygan, Wisconsin

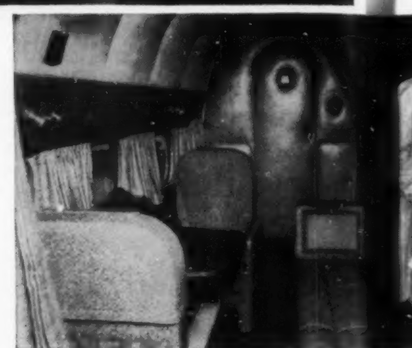
Serving the plastics industry in the manufacture of high grade phenolic molding compounds, industrial resins and coating resins

Portion of urethane foam continuous process unit, F. Burkart Mfg. Co., St. Louis, Mo.

more URETHANE

In these ways:

For relaxable cushioning, soft to the touch, yet not bouncy.



As insulation, padding, carpet underlay and seating.

Because of these advantages:

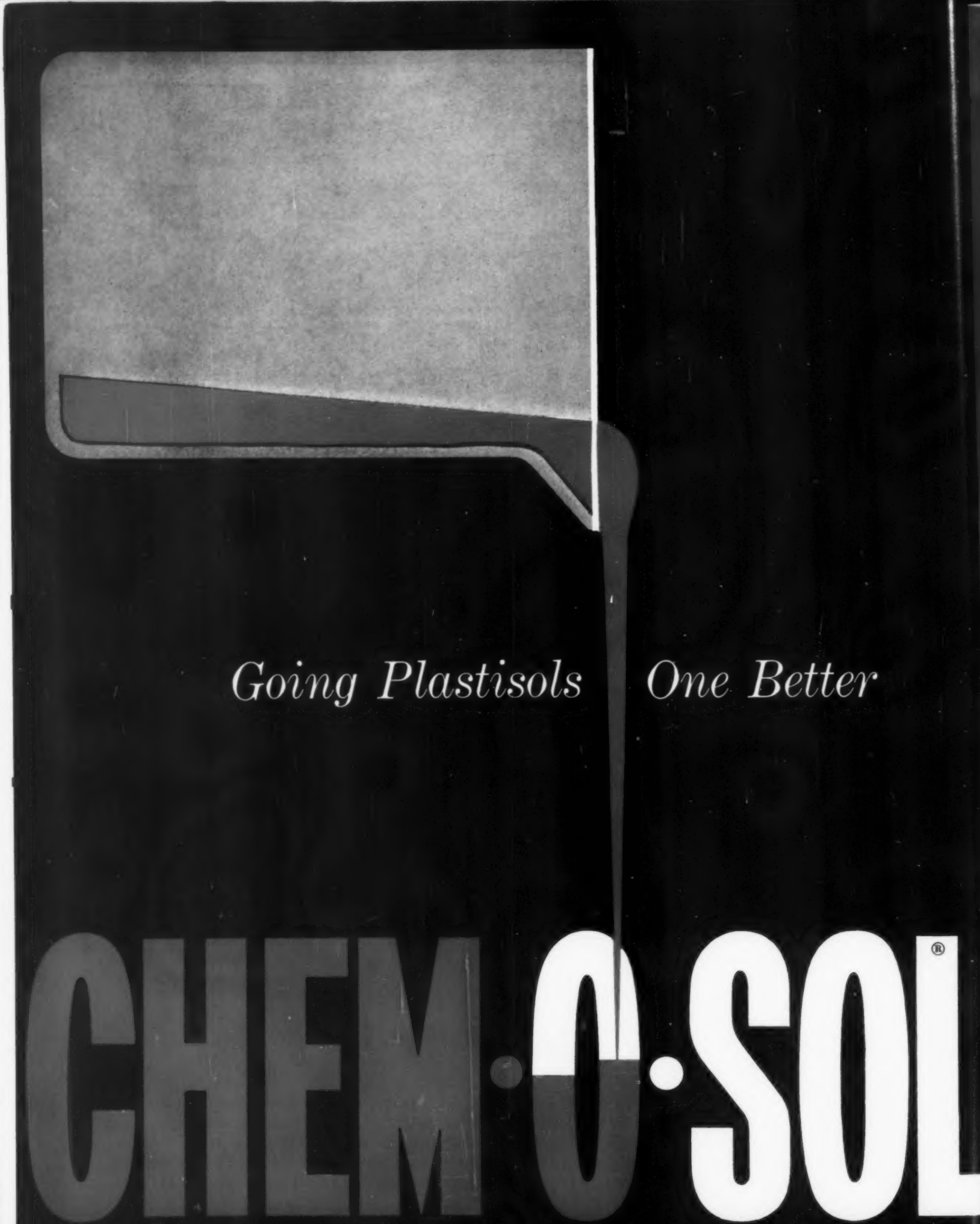
So tough it hog-rings to seating springs without backing support or fabric liners.

Elasticity, durability and structural strength unmatched by any other foam material.

... Plus Functional Utility...

In addition to the above uses, industry leaders are specifying urethane foam for sound and thermal insulation, underlay, footwear, sporting goods, household items, and dozens of other uses because it can be molded, heat-sealed, hot-wire or die-cut, flocked and colored; it's shock-absorbent, density-controllable, resistant to cleaning chemicals, soaps, fire, mildew, heat, cold, abrasion.

Space does not permit listing all of the advantages of urethane foam for the designer, fabricator, manufacturer and consumer. Some of the biggest names in the auto, aircraft and furniture industries call it "the unbeatable combination" for improving design, lowering costs and expanding markets. Write Mobay for the facts and learn why.



Going Plastisols One Better
CHEM-O-SOL®
A specially formulated polyvinyl dispersion of unlimited potential.
Produced in the world's largest plant of its kind,
chem-o-sol is the product of years of research and pioneering experience.
For your copy of the new chem-o-sol brochure –
the definitive work in the field of plastisols – write to
Chemical Products Corporation, Dept. E8, East Providence, R. I.

Look at the clarity of this soft goods package made from a Spencer 2400 Series "Poly-Eth" resin. These resins give you greater stiffness, too.

Draw-down to 0.5-mil or less is possible with "Poly-Eth" resins 2476, 2477 and 2486. These resins are custom-designed for garment bags.

No other .925 density polyethylene resin gives you

More Clarity, Better Draw-Down

. . . and Spencer's 2400 Series lets you choose the melt index and slip that are best for your needs.

Product	Melt Index	Slip
"Poly-Eth" 2405	2	Low
"Poly-Eth" 2425	2	Medium
"Poly-Eth" 2455	2	High
"Poly-Eth" 2476	4	Medium
"Poly-Eth" 2477	8	Medium
"Poly-Eth" 2486	4	High

If you make or use film for soft goods packaging or for garment bags, you should know the facts about Spencer Chemical Company's 2400 Series of "Poly-Eth" Polyethylene resins.

No other polyethylene resin in the .925 density group can give you more clarity or easier processing. And these Spencer resins give you other special advantages, too.

Designed for flat film extrusion, either water bath or chill roll, these resins offer you a variety of properties to fit any specific requirements. For example, you have a melt index choice of two, four or eight. Grades are available with low, medium and high slip.

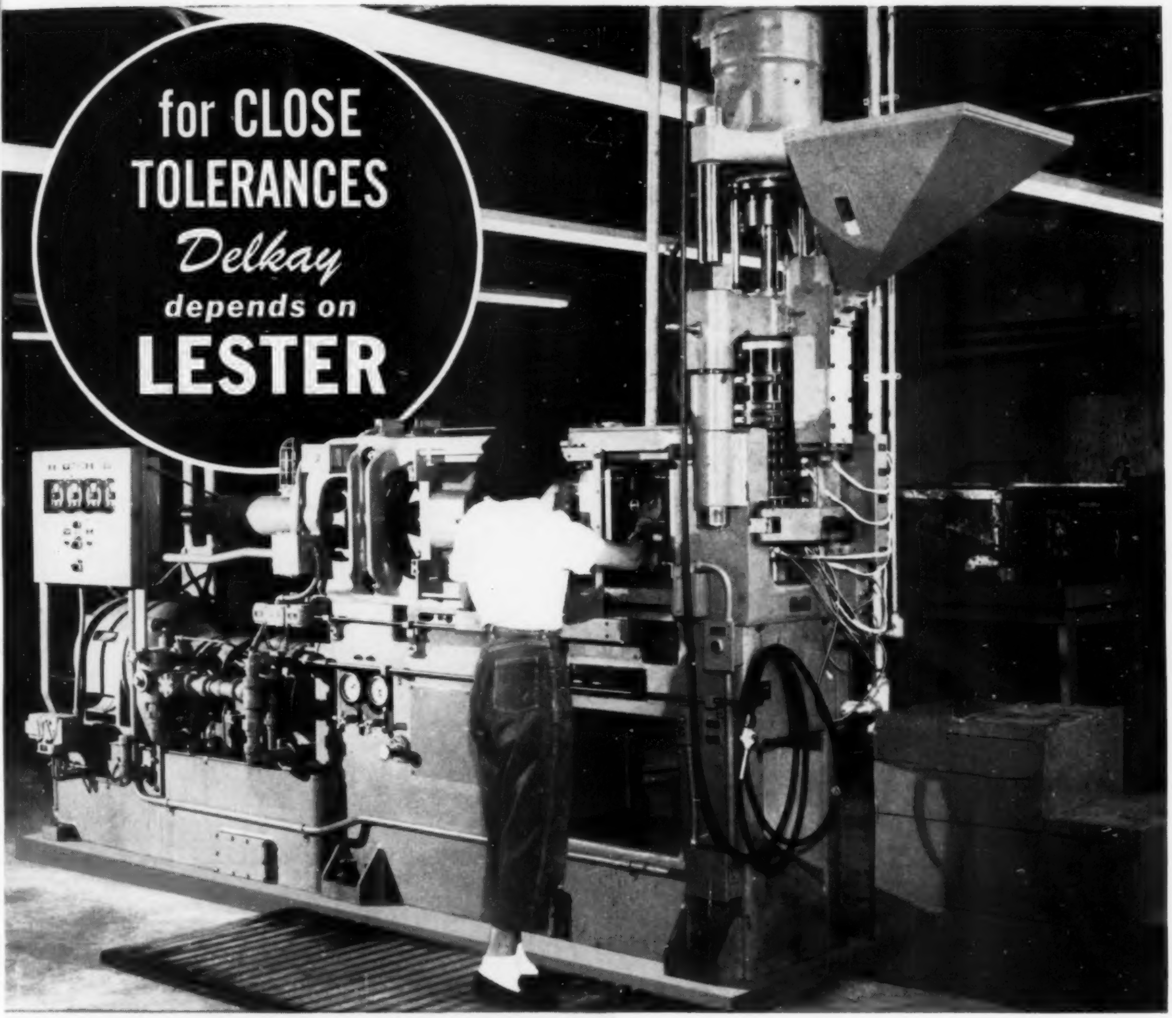
All of these resins are especially designed for soft goods packaging. By actual comparison, this film is up to twice as clear as conventional polyethylene film, and it has a higher gloss. In addition, "Poly-Eth" 2400 series resins make a very stiff film, suitable for many overwrap applications. It's easy to feed into bag machines, and finished bags are easy to stack.

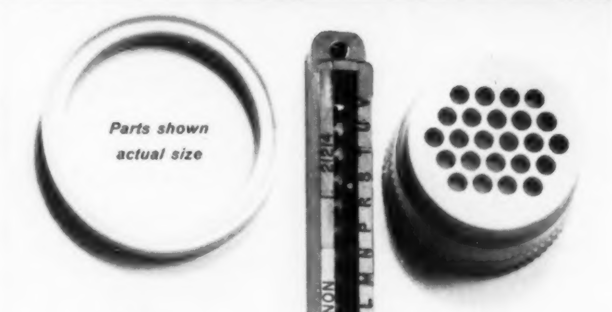
For garment bag film, "Poly-Eth" resins 2476, 2477 and 2486 are tailor-made for gloss, draw-down and stiffness. The film has excellent printing and heat sealing properties, too.

Even with all these advantages a "Poly-Eth" 2400 series resin costs no more than regular polyethylene. So, if you're an extruder, get the complete facts from your Spencer representative. If you are a converter or a package user, be sure to ask your supplier for film made of Spencer "Poly-Eth."

Poly-Eth *by* **SPENCER**

SPENCER CHEMICAL COMPANY
Dwight Bldg., Kansas City 5, Mo


for CLOSE
TOLERANCES
Delkay
depends on
LESTER


Parts shown
actual size

HEAT STABILITY OF PVC RESIN FORMULATED WITH DIFFERENT PLASTICIZERS

PLASTICIZER	Parts Per Hundred Parts of Resin	Heat Stability 2 hrs. @ 350°F.	Approx. Relative Cost* (Isosebacates = 100)
DIOIS (Diisooctyl Isosebacate)	50 60	Excellent Excellent	100
DOIS (Di-2-ethylhexyl Isosebacate)	50 60	Excellent Very Good	100
DOS (Di-2-ethylhexyl Sebacate)	50 60	Very Good Very Good	135
DIOS (Diisooctyl Sebacate)	50 60	Very Good Very Good	135
DOZ (Di-2-ethylhexyl Azelate)	50 60	Very Good Very Good	105
DOP (Di-2-ethylhexyl Phthalate)	50 60	Very Good Good	65
DIOZ (Diisooctyl Azelate)	50 60	Good Good	105
DOA (Di-2-ethylhexyl Adipate)	50 60	Fair Fair	90
DIOA (Diisooctyl Adipate)	50 60	Fair Fair	90
ODA (n-Octyl-n-decyl Adipate)	50 60	Fair Fair	90
DIDA (Diisodecyl Adipate)	50 60	Poor Poor	90

Formulations:	Parts	Parts
PVC	100	100
Plasticizer	50	60
Stabilizer A	2	2
Stabilizer B	1	1

*Based on Aug. 1958 prices for finished plasticizers.

You get top heat stability at low cost by plasticizing vinyls with esters of ISOSEBACIC® acid

Dioctyl and diisooctyl esters of ISOSEBACIC® acid excel over the commonly used sebacates, azelates, adipates and phthalate as heat-stable plasticizers for vinyl resins.

The above table of data from a series of comparative tests shows the outstanding heat stability of Isosebacates. In these tests, samples were cut from sheets of various polyvinyl chloride formulations prepared by standard milling and pressing techniques. Four sets of each were heated at 350°F., with one set removed at each half-hour interval over a two-hour period. Stability was rated according to the degree of discoloration.

DOP was included in these tests since it is often used in blends to increase the compatibility of other plasticizers.

Key to Quality

To manufacturers of such vinyl products as luggage, auto seat covers, handbags, shower curtains, garden hose and footwear, heat stability is a vital property. With ISOSEBACIC acid-derived plasticizers, they get top heat stability—and good color, odor, low-temperature flexibility, and resistance to oil and soapy water extraction as well.

Costs, too, are well below those possible with the best of the other low-temperature vinyl plasticizers.

ISOSEBACIC acid is a mixture of three C-10 dibasic acids—2-ethyl suberic, 2,5-diethyl adipic and sebacic acids. It is a new U.S.I. organic intermediate being evaluated for polyamides, polyesters, polyurethanes and alkyds as well as vinyl plasticizers.

Why not see for yourself how these properties can improve your quality-cost picture? Send for literature and samples of ISOSEBACIC acid, soon to be produced in commercial quantities at Tuscola, Ill.


WHITE
WHITE
WHITE
WHITE
GEL-COTE
!
*PLEOGEN 2048-2
WHITE GEL-COTE
Here's an ISOPHTHALIC base material that is ready to spray after catalyzing . . . no fussing necessary. High-hiding white color gives pleasing appearance. Cures rapidly. Produces tough, glossy, non-brittle surface. Fluffy, thixotropic consistency makes PLEOGEN 2048-2 hang up on the mold without running.
*ANOTHER EXAMPLE OF
MOL-REZ
FIELD PROVEN
QUALITY!
SPECIAL
OFFER*
Send $24.00 for trial 5 gallon pail of PLEOGEN 2048-2. Shipped at once, freight prepaid, Anywhere, U. S. A.
*Expires Feb. 1, 1959
MR
MOL-REZ DIVISION
American Petrochemical Corporation
Minneapolis 18, Minnesota, U.S.A.

THE PLASTISCOPE*

News and interpretations of the news

By R. L. Van Boskirk

Section 1 **January 1959**

Vinyl chloride price reduction. General-purpose vinyl chloride resins have been reduced from 25 to 23½¢ a pound. Resin from which plastisols are produced is now 26½¢, compared with the former 28¢ price. Resin for phonograph records was reduced from 30 to 28½ cents. Copolymer resin used for vinyl-asbestos floor tile is now 24½¢—was formerly 27½.

The price reduction was not unexpected in an industry that has close to a billion lb. capacity but sold only 620 million lb. or so in 1958 and has been constantly plagued with rumors of price-slashing and Japanese imports of low-cost resin. The 25¢ price had been set only last summer from a previous 27¢ level. It is doubtful that the price can decline much lower and leave any profit margin to support research and development.

Vinyl foam for furniture. International Furniture Co., at the recent Chicago Furniture Show, displayed some 50 different pieces of furniture that incorporated molded vinyl foam cushioning developed by Union Carbide Plastics Co. Vinylfoam has been around for several years, but this is the first large-scale adaptation. It has now been tested for five years in actual use in transportation, theaters, movie house seating, and jump seats in cabs. Among its outstanding properties is resistance to fire, oxidation, and hardening.

Produced from a 26½¢ plastisol resin, Vinylfoam is now claimed to be the lowest-cost foam material available for cushioning. Its density is around 3½ lb./cu. ft., which is slightly lighter than foam rubber. But the big saving is in manufacturing. Jump seats for cabs as an example are constructed of five components instead of the eleven previously required at a reported savings of $5.75 per cab. (See MPL, Nov. 1958, p. 160.)

Rigid PVC pipe specified. The City of Miami Beach's electrical code now specifies that rigid unplasticized polyvinyl chloride pipe, Schedule 40, should be used for conduits in certain installations of electrical, signal, and telephone wiring where corrosion is a problem. Applications include electrical wiring in pool decks and pump rooms, underground branch circuits in ocean-front public areas, dock wiring, and for signal and telephone wires when installed underground or in first-floor slabs.

The Florida Power & Light Co. used 2-in. Schedule A, high-impact PVC pipe and Schedule 40 PVC conduit bends to install electrical wiring to oil circuit breakers at the Greynolds Substation, North Miami Beach, Fla. The pipe was extruded by National Tube Div., U. S. Steel Corp. (See "Rigid vinyl—present and future," MPL, Dec. 1958, p. 106.)

Rigid vinyl for transfer molding. A new method for molding unplasticized PVC and its copolymers has been announced by Union Carbide Plastics *(To page 41)*

*Reg. U.S. Pat. Off.

(Continued from page 39)

Co., a Div. of Union Carbide Corp. This material is difficult to mold by injection molding because it is subject to decomposition at the high temperature required in the machine chamber where time of residence in the heating zone may vary from 3 to 20 min.—sometimes even longer because of nonuniform flow.

To overcome this problem UC has applied a type of high-frequency preheating and plunger molding similar to that used in phenolic molding. Powder preblends of rigid PVC resin and an alkyl-tin mercaptide stabilizer are high-frequency-preheated to about 450° F. in 20 to 40 sec., transferred to a plunger pot, and plunger molded at 15,000 to 18,000 p.s.i. pressure.

Rigid PVC has thus been heated into its critical temperature range, molded, and cooled through that range in from 60 to 120 sec., with no appreciable harmful effect on the material or its properties. This method permits molding of thinner sections, gives better weld strengths, and more uniform surface appearance than has been available with conventional PVC molding techniques.

Vinyl coatings in limelight. Use of vinyl chloride resin for protective coatings of one sort or another is expected to become an increasingly important growth area for vinyl in the future. It has been running from 20 to 30 million lb. a year for the last five years. This amount of resin accounts for millions of square yards of surface since a pound of resin in coating form will cover such a large area.

One of the new developments expected to make great stride is a Geon vinyl coated aluminum siding. This clapboard-like siding, furnished in most any color is expected to maintain its finish for many years and can be washed down with a garden hose. Both sides are coated before application and the metal can be formed, bent or otherwise handled without affecting its appearance. The siding is marketed by Hastings Aluminum Products, Hastings, Neb. and the coating is by Sherwin Williams.

Another new coating expected to grow is Union Carbide's new wrinkle finish based on plastisols, organosols, and solutions. An important ingredient in these new finishes is Monomer MG-1, which is a polymerizable plasticizer introduced several years ago by UC and is now claimed to be the principal factor in obtaining the wrinkle finish.

Still another coating, although an entirely different type than the surface coatings named above, is the vinyl plastisol containing powdered lead which is used to treat cotton or fiber glass fabric that will absorb low frequency engine sounds in jet airliners. The material, called Coustifab, can be used as a sound dampener for office machines and for lightweight aprons and wall covering in X-ray rooms. It was developed by Cordo Chemical.

New plant for polyvinyl alcohol. Borden Chemical Co. is building a new PVA plant to produce 5 million lb. a year. The facility will adjoin the company's present PVA plant at Leominster, Mass., where the company also makes PVC, PVAc beads, and specialty monomers. A new process that will be versatile enough to produce all grades and viscosities on a continuous process will be employed. Water-soluble PVA sheeting is used for packaging soap flakes, detergents, food products; PVA for adhesives and textile sizing or finishing. *(To page 43)*

THE PLASTISCOPE

(Continued from page 41)

Styrene-methyl methacrylate copolymer. Dow Chemical Co. announces availability of a new styrene-methyl methacrylate copolymer molding material, named Zerlon 150. It is said to have excellent clarity, weatherability, processability, toughness, good strength, heat resistance, and light stability.

Priced at 49 to 50½¢/lb., it will obviously be aimed at markets now occupied by 55¢/lb. methacrylate molding material—horn buttons, medallions, knobs, dials escutcheons, light fixtures, boat windshields, and outdoor signs. How it will compete from a properties point of view is still to be proven by actual use. Dow states that its ultimate potential will be determined by experimentation in across-the-board applications.

More Mylar soon. Manufacturing capacity for Mylar polyester film will be increased by 30% in an expansion of Du Pont's plant at Circleville, Ohio. New facilities will be ready in 1960. This is the second announced expansion, but Du Pont has never given its capacity. Leading outlets for Mylar are electrical insulation, magnetic tape, and a base for metallic textile yarn; but laminates with other films, fabrics, and leather are coming along fast. A new application of this sort in 1958 was a covering over vinyl windlacing for automobiles.

Another linear polyethylene plant. Du Pont's often mentioned plant for production of linear polyethylene is expected to be built and completed by mid-1960 at Orange, Texas, according to a recent announcement. The company has been operating a pilot plant at the Sabine River Works for three years.

The company will use a process of its own (although it is known to have a Ziegler license) and will fall under the composition-of-matter patents which Du Pont announced a year ago. An affiliate firm, Du Pont of Canada is also building a linear polyethylene plant at Sarnia, Ontario, Canada.

Plant capacity for producing linear polyethylene in the U.S. was over 300 million lb. before this announcement was made. Sales in 1958 were estimated at varying quantities of from 40 to 65 million lb., but some producers predict that sales will be double that amount in 1959. Some usually well-informed analysts predict that half of the polyethylene produced five years from now will be of the linear type. Du Pont's faith in the future for linear PE is indicated by its new announcement.

New methacrylate for extrusion. Du Pont has announced a new extrusion methacrylate resin called Lucite 147. This resin, to sell for 55¢—the same as molding grade—has been developed exclusively for extrusion in contrast to previous grades that were developed from molding resins.

It will be available in transparent, translucent, and opaque grades. Embossing of the warm sheet as it comes out of the extruder is possible, and it will have economic advantages over cast sheet in applications where optical properties are not applicable. It is suggested for auto and boat trim, building facings and decorations, fluorescent lighting, and signs.

For additional and more detailed news see Section 2, starting on p. 202

HERE'S THE STORY ABOUT **Moplen*** POLYPROPYLENE: Unique combination of properties makes "MOPLEN" resins a promising new plastic ... Toughness and high melting point are particularly valuable ... This is the first of a family of plastics molecularly constructed to provide desired physical properties.

"MOPLEN's" PROMISE (*No. 6 in a series*)

Structure of the New Plastic

Isotactic polypropylene is the first of a new class of stereospecific polymers discovered by Giulio Natta of the Milan Polytechnic Institute in 1954. A variety of polymers of this class can be produced depending on the monomer type, which can be propylene, butylene, styrene, etc. Polypropylene is the first of this family to be produced commercially, following extensive industrial development under the sponsorship of Montecatini Co. "MOPLEN" is the trade mark for Montecatini's isotactic polypropylene.

Such polymers have a sterically regular structure within the macromolecule and are called "isotactic" polymers. Their main linear head-to-tail chains contain long sequences of tertiary carbon atoms presenting the same steric configuration. This type of stereoisomerism provides the polymers with new and unforeseen properties. They are tough and have high melting points.

The isotactic polymers are obtained by means of heterogeneous catalysts, which are called "stereospecific" because they selectively direct polymerization toward the production of isotactic, high molecular weight materials.

The chemical structure of polypropylene can be represented by the following simplified formula, in which the tertiary carbon atoms with the same steric structure are marked with an asterisk:

$$-CH_2-\underset{\substack{|\\H}}{\overset{\substack{CH_3\\|}}{C^*}}-CH_2-\underset{\substack{|\\H}}{\overset{\substack{CH_3\\|}}{C^*}}-CH_2-\underset{\substack{|\\H}}{\overset{\substack{CH_3\\|}}{C^*}}-CH_2-\underset{\substack{|\\H}}{\overset{\substack{CH_3\\|}}{C^*}}-$$

Isotactic polypropylene is a tough, strong thermoplastic material with a high melting point. It is the first of a family of plastics produced by "constructing" the molecule so as to provide predetermined physical properties. In general, polypropylene, in comparison with high density polyethylene, is somewhat stronger and tougher, has higher heat resistance, and is about equal in chemical resistance and electrical properties.

Applications

Because of the combination of properties unique to polypropylene, the range of applications for the material is extremely wide. The material is being widely used commercially in Europe and has been marketed in the United States since early 1958 for various end uses.

The yield strength of polypropylene, which is considerably higher than that of known polyethylenes, indicates interesting possibilities for the material as structural parts, particularly in the piping field where the material's chemical resistance provides additional benefits. Long time tests are currently under way to establish maximum permissible loads in relation to conditions of use.

The combination of high surface hardness, excellent gloss, strength and low friction coefficient makes polypropylene particularly promising for industrial items that require a high finish, such as spools and other parts for the textile industry; headlight cases and reflectors, etc., for the automotive industry; and radios and tape recorders.

Packaging applications for polypropylene film appear most promising.

Other potential applications are in electrical components, sanitary ware, appliances and industrial parts.

For more detailed information about "MOPLEN" write, outlining area of interest, to

Chemore Corporation
General Representative in U.S.A. & Canada for Montecatini
21 West St., New York 6, N. Y.

Professor Giulio Natta, the architect of a new era in structural chemistry, has made a discovery of a whole new order of matter. Thanks to his work, scientists and engineers now have the tools and the understanding necessary to enable them to select and adjust the kind of polymer structures demanded by a given end product need. First commercial fruit of Natta's work is Montecatini's recently marketed "MOPLEN" polypropylenes.

*Montecatini Trademark

MONTECATINI

Soc. Gen., Milano, Italy

U. S. Representatives: CHEMORE CORPORATION • 21 WEST STREET, NEW YORK 6, N. Y. HANOVER 2-5?75

SMD-3500

A free-flowing polystyrene compound offering both excellent moldability and fast set-up. Along with low bulk factor, this material provides good electrical, mechanical and optical properties. Widely used for injection molding operations.

TMDA-6000

A high-impact, rubber-modified polystyrene with low bulk factor, free flow and quick set-up. Izod impact strength is as much as 5 times that of general-purpose styrenes.

TMDA-9001

Good flow and fast set-up are combined in this medium-impact, rubber-modified polystyrene. Surface gloss and translucency are excellent. Widely used for caps, closures and containers.

RMD-4511

Possesses exceptional resistance to chemicals and high heat, as well as unusual flexural and tensile strength properties. These make this acrylonitrile-styrene copolymer ideal for surface hardness, dimensional stability and rigidity in service.

TMDB-5161

In addition to a high heat distortion point, this high-impact, rubber-modified polystyrene affords superior mechanical strength and good electrical properties. An outstanding material for radio cabinets and similar applications. Molds with good flow and release; set-up is fast; surface gloss is superior; colors are excellent.

TMDB-2155

A rubber-modified polystyrene with extra-high impact strength even at temperatures of −25° C. **Strongest rubber-modified styrene on the market today!** Molding properties are excellent; ease of flow at molding temperatures; fast cycles; good mold release; and a minimum of strains and weld lines.

Which styrene would you choose for this product?

"BAKELITE" PLASTICS
BRAND

VINYLS • EPOXIES • STYRENES
C-11 STYRENES • PHENOLICS
POLYETHYLENES • IMPACT STYRENES

1029

THE PRODUCT:

Domestic food waste disposer encased in a sound-deadening, molded plastic shell. Designed by Waste King Corporation, this "Super Hush" model is quieter —lighter, easier to install—combines attractive colors with durability. Molded by Industrial Molding Corp., Culver City, Calif. and Modern Plastic Co., Los Angeles, Calif.

THE PROBLEM:

Pick a plastic which affords ease of molding to the "sculptured" design desired. In addition, provide for chemical inertness, resistance to heat, and excellence of color and lustre. Above all, provide for durability in service with properties of high impact strength.

THE SOLUTION...

to this manufacturing problem is in the *wide selection* of BAKELITE Brand Polystyrenes. If you selected TMDB-5161 as your choice for this "Waste King" Pulverator you matched up properties to performance requirements *exactly* as countless of fabricators are doing every day with BAKELITE Brand Plastics.

For the right styrene to meet *your* needs exactly, discover the full range of BAKELITE Brand compounds. And, to assist you in your selection, call on the services of your Bakelite Company Technical Representative —or write Dept. IC-29G.

In addition to the styrene molding materials described at left, Bakelite Company provides for your selection these others:
SMD-3000 (unmodified heat-resistant Styrene)
SMD-3700 (high-flow Styrene for containers)
RMD-4500 (high-clarity Acrylonitrile-Styrene)

UNION CARBIDE PLASTICS COMPANY

Division of Union Carbide Corporation

30 East 42nd Street, New York 17, N. Y.

UNION CARBIDE

In Canada: Carbide Chemicals Company, Division of Union Carbide Canada Limited, Toronto 7

Sylvania's new catalog of vacuum metallizing coils lists 164 shapes and sizes. Most of these have become standards for efficiency in the applications for which they were designed.

Whether your interest is in finished coils or top-quality stranded wire, if you form your own coils, Sylvania can help you.

Here's how to find the one coil that's best for you

Sylvania can help analyze your coil needs if you supply us with the following information:

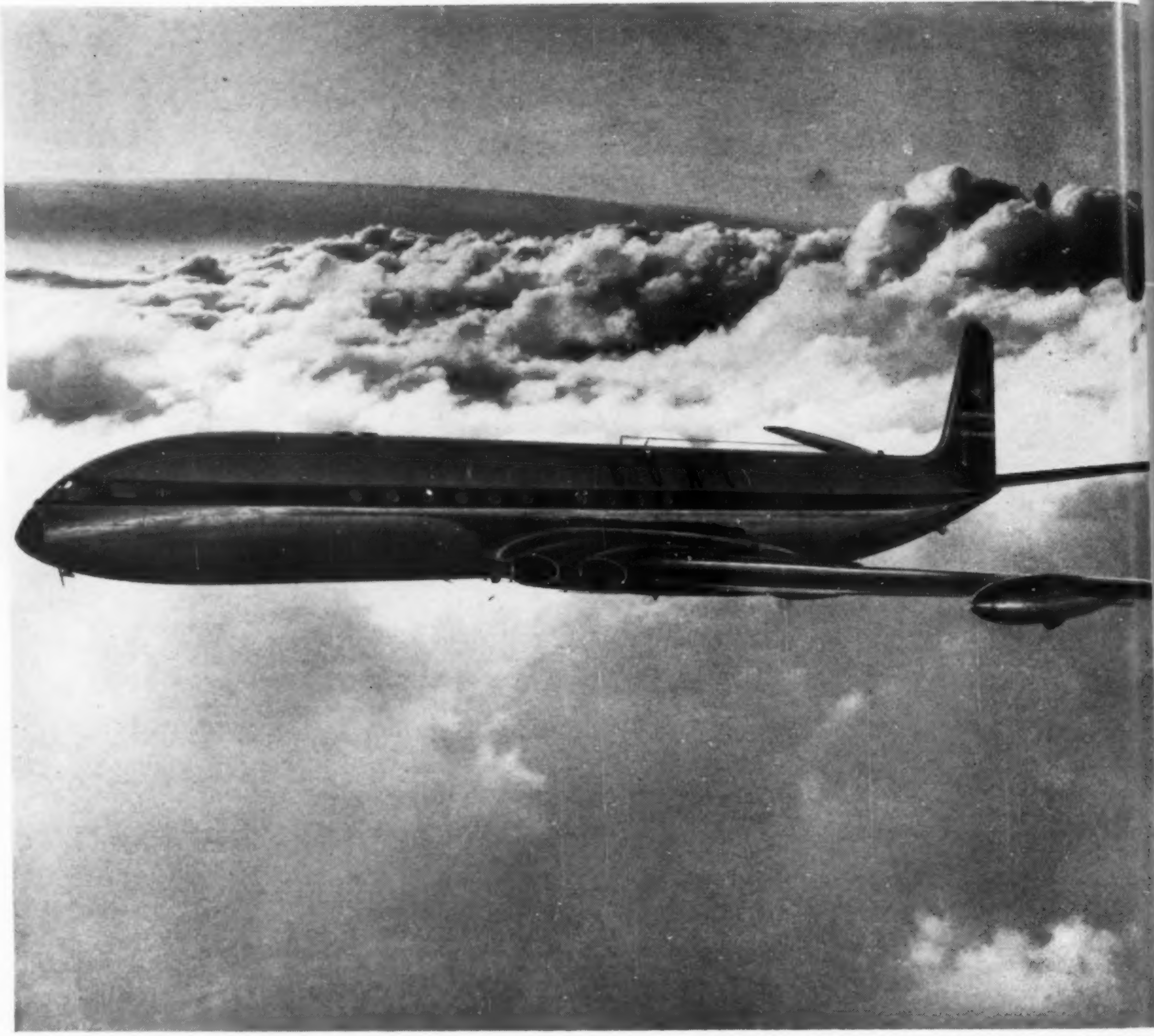
1. What type and weight material is being evaporated?
2. What material is being coated?
3. What is the length and diameter of your equipment?
4. What is the power supply to the coil and the distance between electrodes?

Address this information or your request for Sylvania's new catalog to:
Vacuum Metallizing Coils
Sylvania Electric Products Inc.
Towanda, Pennsylvania.

SYLVANIA

SYLVANIA ELECTRIC PRODUCTS INC.
Chemical & Metallurgical Div.
Towanda, Penna.

TUNGSTEN • MOLYBDENUM • CHEMICALS • PHOSPHORS • SEMICONDUCTORS



These I.C.I. plastic materials were chosen for the B.O.A.C. Comet 4, the world's first jet airliner to enter transatlantic passenger service.

I.C.I. plastics chosen for Comet 4

The very successful interior decoration schemes designed by Gaby Schreiber for the Comets make use of 'Darvic' & 'Perspex' and 'Fluon' p.t.f.e. is extensively used for specialised engineering and electrical applications.

One of the most interesting uses of 'Fluon' p.t.f.e. is in nearly 400 Glacier dry bearings supplied by the Glacier Metal Co. Ltd., for each Comet 4. These bearings require no lubrication because of the excellent non-stick property of 'Fluon'.

'Fluon' p.t.f.e. is also used in navigational aid equipment.

The properties of 'Fluon' important for aircraft applications are: exceptional working temperature range, from +250°C down to the temperature of liquid nitrogen; resistance to corrosion and degradation from ageing over an indefinite period; excellent electrical and chemical properties; ability to withstand frettage and vibration even at high temperatures; and toughness combined with flexibility.

'Perspex' acrylic sheet was used for lighting fittings, windscreens, and windows. 'Perspex' is tough, light, attractive and easy to maintain. It is not affected by bad weather or atmospheric changes and gives an extremely high light transmission in clear sheet.

'Darvic' p.v.c. was chosen for window surrounds and mirror surrounds in toilet compartments. 'Darvic' is tough, light and hygienic. It will not corrode and is available in a wide range of attractive colours including multi-colour laminates.

'PERSPEX' 'DARVIC' 'FLUON'

'Perspex', 'Darvic' and 'Fluon' are registered trade marks, the property of I.C.I.

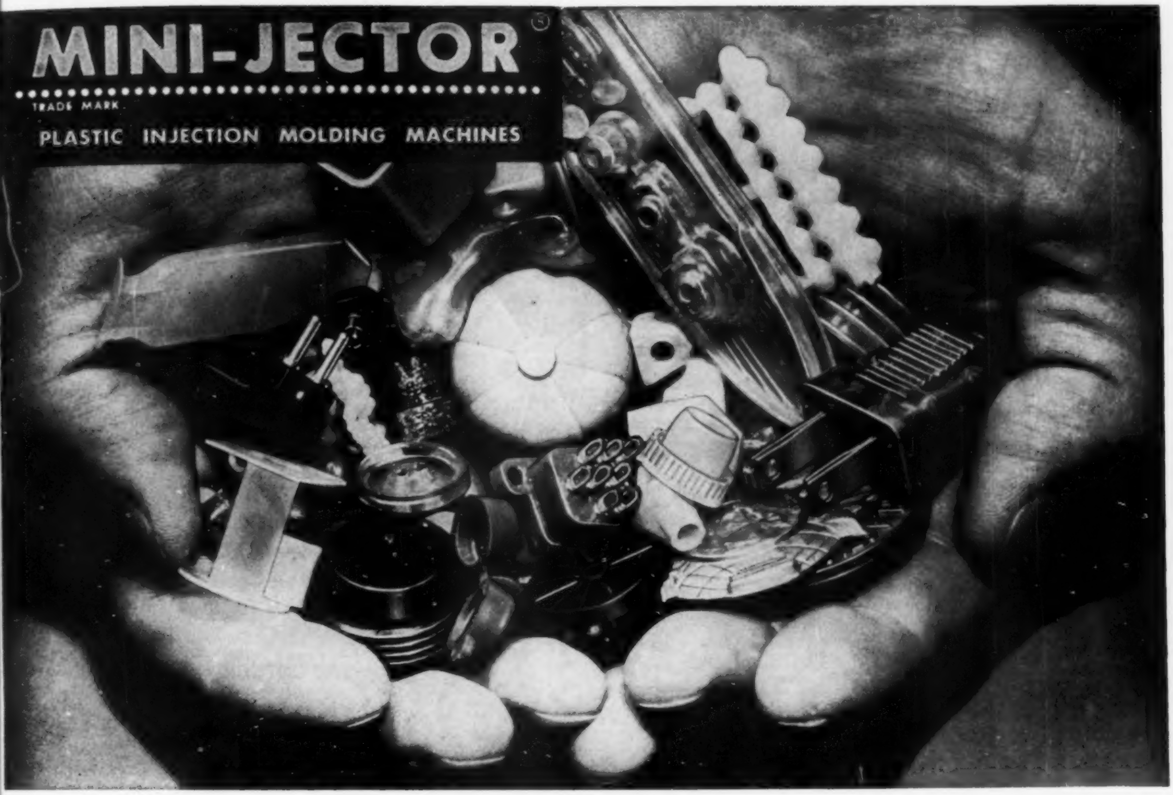
Imperial Chemical Industries Limited, Plastics Division: Export Dept., Black Fan Road, Welwyn Garden City, Herts.

U.S.A. enquiries to:
J. B. Henriques Inc., 521 Fifth Avenue, New York 17, N.Y.

Canadian enquiries to:
Canadian Industries Ltd., Plastics Dept., Box 10, Montreal, P.Q.

ICI

OP 40

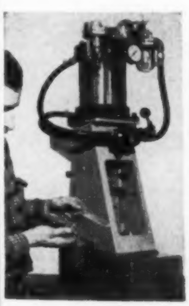


MORE VARIETY AT LOWER COST

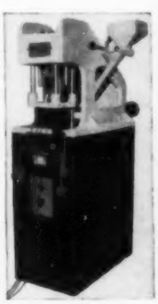
One MINI-JECTOR user saved over $4,000 in mold costs on one of the above items alone. Details on request.

If your production requirements are such that big press tooling can be avoided, you can be sure of substantial savings. The more the variety, the bigger the savings. Flexible, efficient MINI-JECTOR plastic injection molding machines answer the critical need for lower cost development and production of fast-changing varieties of small precision-molded plastic items. Savings begin with low initial machine investment (some under $1,000) and mold blanks (as low as $29.50).

More important are the major savings in time, trouble and money developing and producing wide varieties of items by eliminating complex, costly big press tooling where not needed.



"Wasp"



"Eldorado"

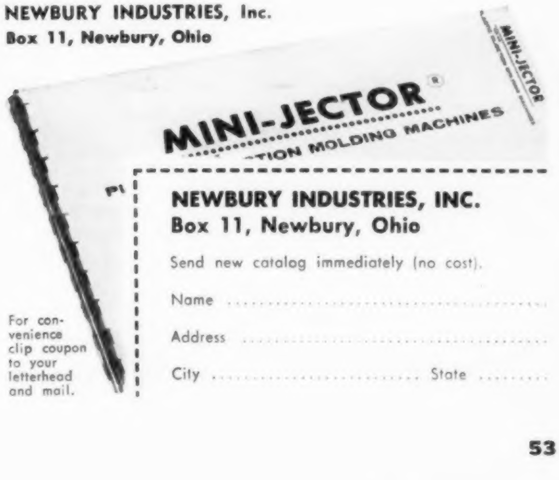
"Hornet"

There are **three basic MINI-JECTOR models**—"Wasp," "Eldorado" and "Hornet" series—with many variations of each to meet your special requirements. They are offered with air or hydraulic power. Some have lever control, some push button controls, some with semi-automatic operation. See catalog.

MINI-JECTOR solves your tight margin runs, from test samples to steady production of 1/3 oz. to 1½ oz. capacity; also, tricky insert or loose core molding in all thermoplastics, including Nylon. Simple to operate; lever and push-button control models; air or hydraulic power to fit your facilities.

See complete MINI-JECTOR Line of Machines and Accessories. Illustrated catalog presents detailed specifications; technical data on performance, applications, prices; and the newest developments in plastic injection molding of small parts, including those involving inserts or loose cores. Shows how MINI-JECTOR has modernized methods in hundreds of plants. Mailed free at your request.

NEWBURY INDUSTRIES, Inc.
Box 11, Newbury, Ohio



For convenience clip coupon to your letterhead and mail.

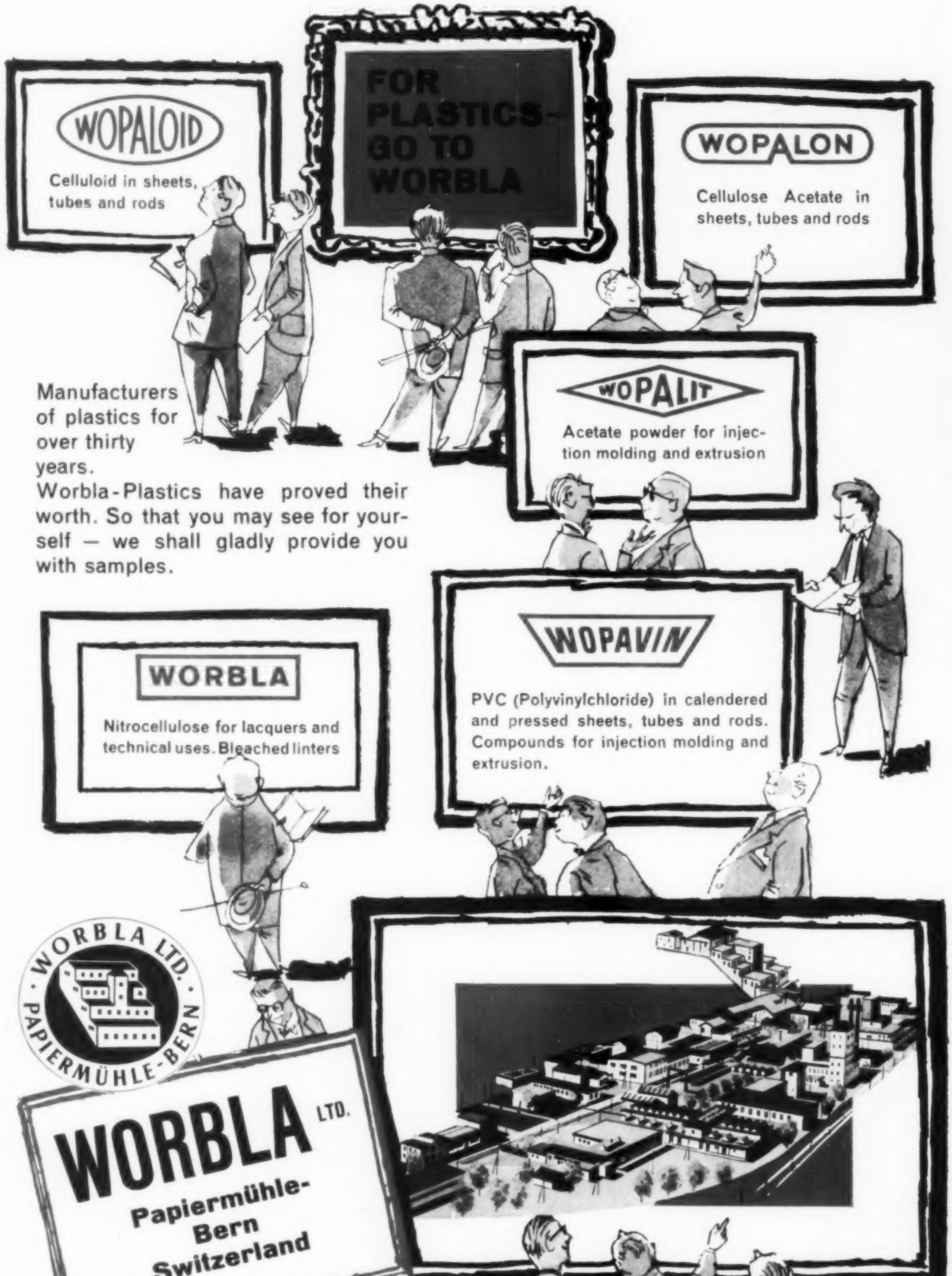
NEWBURY INDUSTRIES, INC.
Box 11, Newbury, Ohio

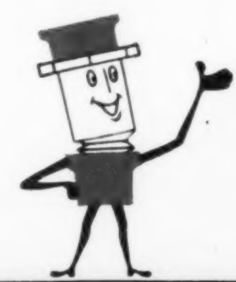
Send new catalog immediately (no cost).

Name ....

Address ....

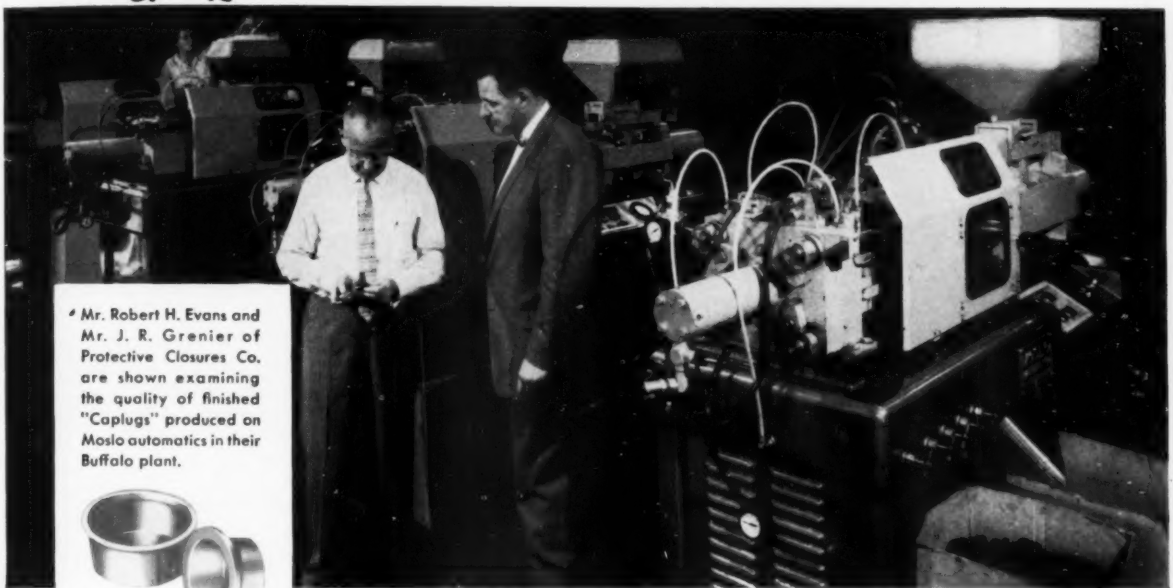
City .... State ....


WOPALOID
Celluloid in sheets, tubes and rods
FOR PLASTICS- GO TO WORBLA
WOPALON
Cellulose Acetate in sheets, tubes and rods
WOPALIT
Acetate powder for injection molding and extrusion
Manufacturers of plastics for over thirty years.
Worbla-Plastics have proved their worth. So that you may see for yourself – we shall gladly provide you with samples.
WORBLA
Nitrocellulose for lacquers and technical uses. Bleached linters
WOPAVIN
PVC (Polyvinylchloride) in calendered and pressed sheets, tubes and rods. Compounds for injection molding and extrusion.
WORBLA LTD. PAPIERMÜHLE-BERN
WORBLA LTD.
Papiermühle-Bern Switzerland



PROTECTIVE CLOSURES CO.

profits three ways



• Mr. Robert H. Evans and Mr. J. R. Grenier of Protective Closures Co. are shown examining the quality of finished "Caplugs" produced on Moslo automatics in their Buffalo plant.

Caplugs with MOSLO Molding Machines

Protective Closures Co., Inc. of Buffalo, New York, is a leading producer of high quality products in the closure industry. In their plant they have a battery of eight MOSLO Model 74 two-ounce automatics to produce their fast-growing line of "Caplugs."

Mr. J. R. Grenier of Protective Closures says, "We selected Moslo presses over larger equipment because less expensive molds, with fewer cavities, can be run fully automatically for greater efficiency and increased profits."

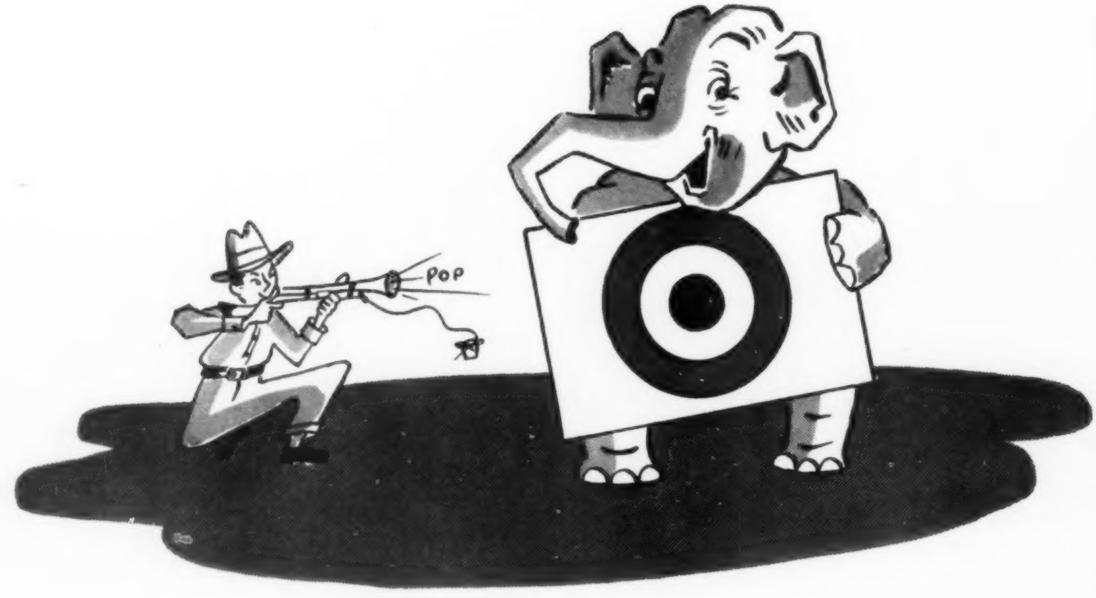
The clean, simple and efficient design of Moslo Plastic Injection Molding Machines, for automatic production of small plastic parts up to 4 ounces can help your profit picture, too. Write today for additional literature on the machines with "Built-in Efficiency."

WORLD'S FINEST PLASTIC INJECTION MOLDING MACHINES

MOSLO
MACHINERY COMPANY
2442 Prospect Avenue
Cleveland 15, Ohio

Please send descriptive literature on
☐ Model "74" 2 ounce Automatic
☐ Model "75" 4 ounce Automatic
☐ "Duplimatic" for cord plug and insert molding

Name __________ Title __________
Company __________
Address __________
City __________ State __________



no one can hunt ELEPHANTS with a POP GUN

We at PEERLESS know you can't do a sound marking job with inferior equipment. Outdated marking machinery, as you well know, will tend to slow production and make costly errors. Look around your plant . . . decide for yourself whether you're hunting elephants with a pop gun!

Whether it be hand, air or electrically operated, marking machinery . . . remember PEERLESS has the outfit to best suit your needs. You'd be amazed at how much in time and money PEERLESS can save you.

Call or write us about your problem. We'll solve it.

Achievement toward Perfection

PEERLESS ROLL LEAF COMPANY, INC.

4511 - 4515 New York Ave., • Union City, N. J.

BRANCH OFFICES: BOSTON • CHICAGO • *Peerless Roll Leaf Division* • GANE BROS. & LANE, INC.
REPRESENTATIVES: ST. LOUIS • LOS ANGELES • SAN FRANCISCO • LOUISVILLE • MONTREAL • LONDON, ENG.

Higher screw speeds...

NRM 2½" Induction Heated Plastics Extruder

for NRM *Thermoplastics* EXTRUDERS

To have profit-making advantages like these *always* at highest peaks of effectiveness in its Extruders, NRM has always searched aggressively for the "better way" to extrude thermoplastics. In this spirit, NRM pioneered development of high speed extrusion, and in January, 1956, made commercially available the first machines *specially* designed to extrude at high screw speeds. They set new concepts in higher quality extrusions at higher lbs/hr rates . . . typical production for a 2½" High Speed NRM Model 50 with 25 h.p. drive extruding Polyethylene pipe being 184 lbs/hr at 148 r.p.m., as compared to 100 lbs/hr at 72 r.p.m. for standard machines with 15 h.p. drive.

Today, NRM Extruders are available to provide the increased production advantages of high screw speeds which so short a time ago was *new* development, requiring special machines. For instance, typical production of the latest NRM Model 60 2½" Extruder, in either resistance or *Induction Heated* Models, is 180 to 200 lbs/hr at 150 r.p.m. with 25 h.p. drive. Larger extruders give correspondingly higher production, as shown in this table:

	Screw RPM	Nominal Lbs./Hr.	HP Based on 7.5#/HP./Hr
3½"	106	350/375	50
4¼"	98	550/600	75
6"	72	1000/1200	150

We'd like to give you detailed facts on *why* NRM Extruders give you "tomorrow's engineering — and performance — today!" High screw speeds are part of the answer, but there are many more . . . all contributing to greater profit on extrusion. We'll be happy to discuss your extruder requirements and recommend the right type and size NRM equipment to do your work most efficiently. Contact us today.

2041-A

NATIONAL RUBBER MACHINERY COMPANY

NRM

Creative Engineering

General Offices and Engineering Laboratories: 47 West Exchange St., Akron 8, Ohio
SOUTH: The Robertson Company, Rutland Building, Decatur, Ga.
WEST: S. M. Kipp, Box 441, Pasadena 18, Cal.
CANADIAN: F. F. Barber Machinery, Ltd., 187 Fleet St., West, Toronto, Ont.
EXPORT: Omni Products Corporation, 460 Fourth Ave., New York, N. Y.

Wherever you need maximum strength per pound of reinforcement . . . high standards of quality . . . uniformity in weight, weave and thickness . . . contact FLIGHTEX for fast service.

Our research laboratories and development facilities are ready to help find the exact fabrics to meet your particular needs.

Write, wire or call for fast service. Get to know FLIGHTEX—you'll like our way of doing business.

Write for our Specification Guide.

FLIGHTEX FABRICS, INC.

93 Worth St. New York 13, N. Y.

Temperature extremes—which can rob vinyls of flexibility—are of little concern to producers who specify Plastolein low temperature plasticizers for their products. For example . . .

They know that Plastolein 9058 DOZ is the time-tested standard of the low temperature plasticizer field . . . that it provides the kind of low temperature flexibility *that stays in* their vinyls even after prolonged exposure to summer heat.

And more and more producers are utilizing the unusual capabilities of another Emery plasticizer, Plastolein 9078 LT, which approximates 9058 performance, but at a much lower price.

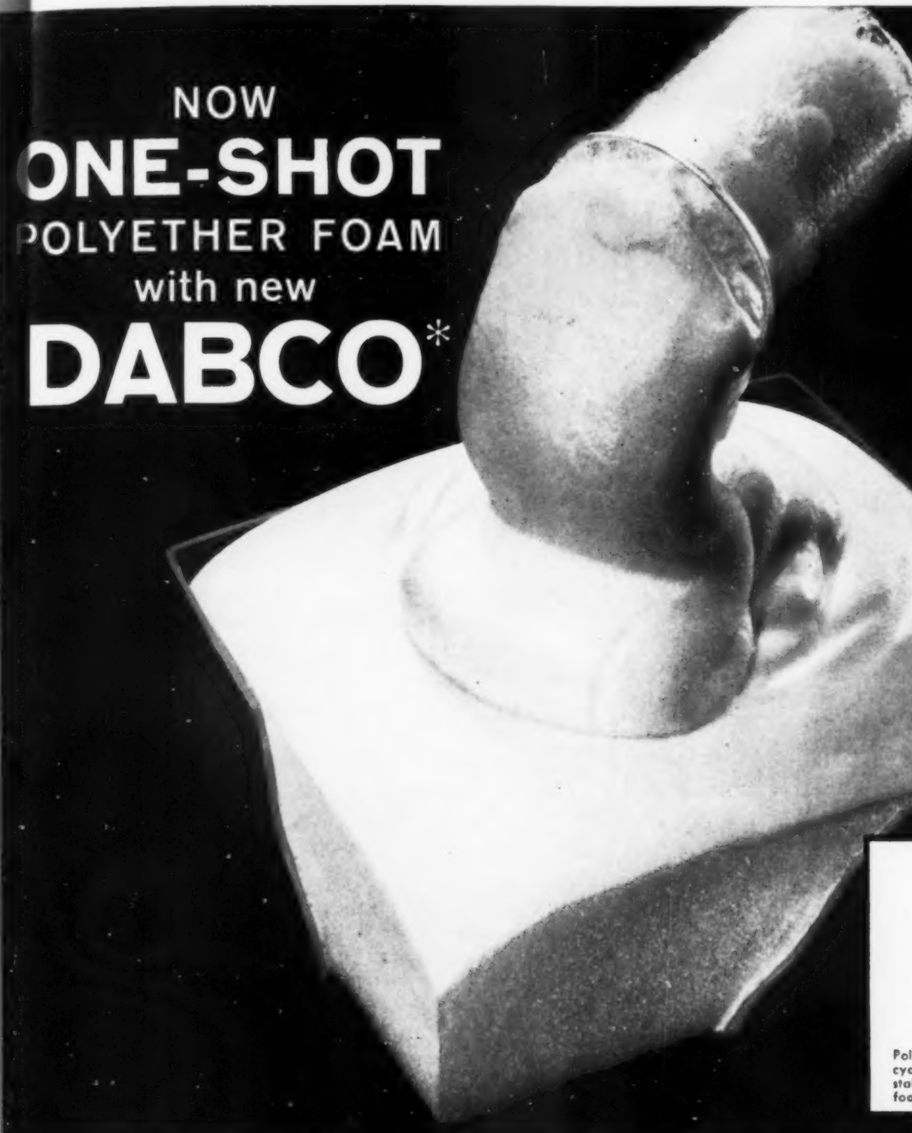
Why don't *you* investigate the advantage of these Plastolein Plasticizers in your coated fabrics, film, sheeting and extrusions?

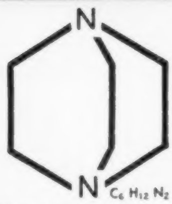
Write Dept. **F-1** for literature.

Emery **Plastolein® plasticizers**

Organic Chemical Sales Department

Emery Industries, Inc., Carew Tower, Cincinnati 2, Ohio



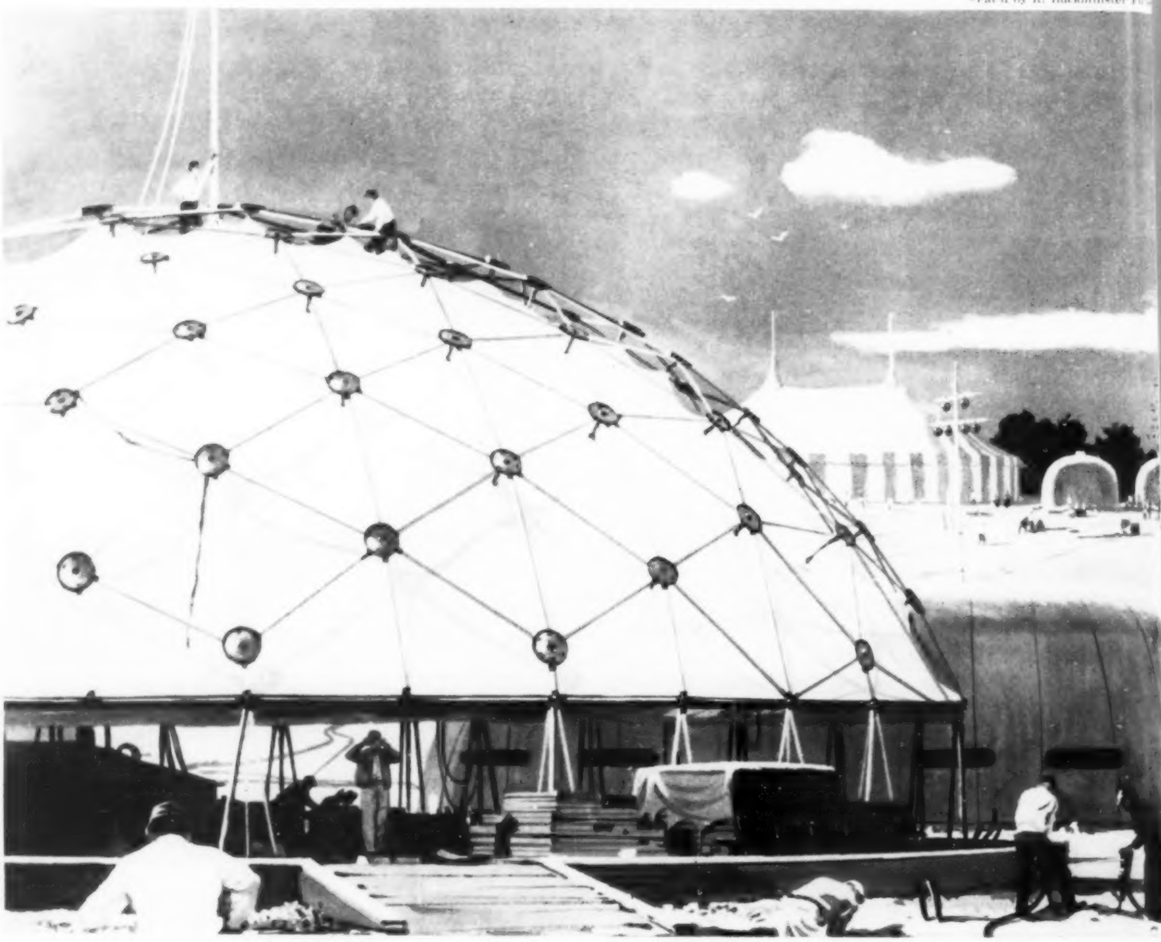


$C_6H_{12}N_2$

Polyether glycol + Toluene diisocyanate + DABCO, water and stabilizer = one-shot polyether foam

• "Geodesic"* structure is made of vinyl coated "Welkote," Wellington Sears nylon fabric engineered for vinyl and neoprene coating. Fabric is suspended from its rigid framework —no interior posts or supports.

*Pat'd by R. Buckminster Fu



"Inside-Out" Building— made with fabric

Fabric does it: a new kind of building, with its skeletal structure on the *outside!* A hose, a brake diaphragm, a radome, a truck cover. Wherever and whenever new products and processes call for new fabrics for coating and laminating, Wellington Sears answers. Over a century of experience in industrial fabrics helps make the answers come more easily. Why not bring us *your* fabric problem? For free booklet, "Fabrics Plus," write Dept. **K-1.**

WELLINGTON SEARS

FIRST In Fabrics for Industry

• For Coated Materials, High and Low Pressure Laminates, and Other Reinforced Plastic Products

Wellington Sears Company, 111 W. 40th St., N.Y. 18, N.Y.

Atlanta • Boston • Chicago • Dallas • Detroit
Los Angeles • Philadelphia • San Francisco • St. Louis

WEST POINT TEXTILES

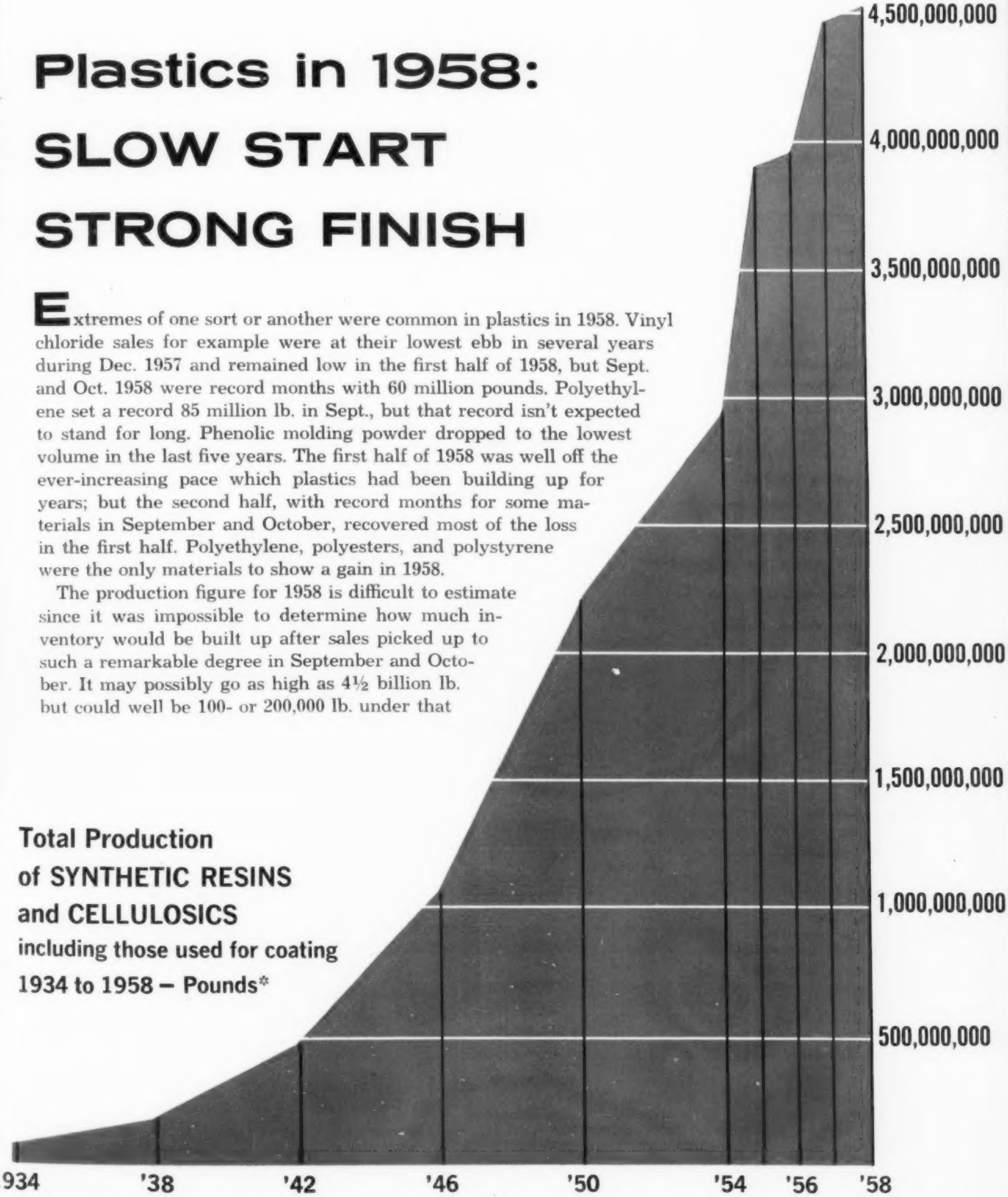
January 1959, Volume 36, Number 5

MODERN PLASTICS

Plastics in 1958: SLOW START STRONG FINISH

Extremes of one sort or another were common in plastics in 1958. Vinyl chloride sales for example were at their lowest ebb in several years during Dec. 1957 and remained low in the first half of 1958, but Sept. and Oct. 1958 were record months with 60 million pounds. Polyethylene set a record 85 million lb. in Sept., but that record isn't expected to stand for long. Phenolic molding powder dropped to the lowest volume in the last five years. The first half of 1958 was well off the ever-increasing pace which plastics had been building up for years; but the second half, with record months for some materials in September and October, recovered most of the loss in the first half. Polyethylene, polyesters, and polystyrene were the only materials to show a gain in 1958.

The production figure for 1958 is difficult to estimate since it was impossible to determine how much inventory would be built up after sales picked up to such a remarkable degree in September and October. It may possibly go as high as 4½ billion lb. but could well be 100- or 200,000 lb. under that



Total Production of SYNTHETIC RESINS and CELLULOSICS including those used for coating 1934 to 1958 — Pounds*

*Source: U. S. Tariff Commission and Modern Plastics Estimates.

Consumption in pounds of synthetic resins and cellulosics, including surface coatings, in 1958[a]

Cellulose plastics		
Cellulose acetate and mixed esters		
Sheets under 0.003 gage	16,500,000	
Sheets 0.003 gage and over	18,500,000	
All other sheets, rods, and tubes	8,200,000	
Molding and extrusion materials	88,000,000	
TOTAL		131,200,000
Nitrocellulose sheets, rods and tubes		4,000,000
Phenolic and other tar-acid resins[b]		
Molding materials	161,000,000	
Laminating resins	64,000,000	
Abrasives	13,000,000	
Friction materials, brake linings	15,000,000	
Plywood	48,500,000	
Thermal insulation binder	49,000,000	
All other bonding resins	40,000,000	
Protective coatings, modified and unmodified	48,000,000	
Miscellaneous	30,000,000	
TOTAL		468,500,000
Urea and melamine resins		
Textile-treating and textile-coating resins	36,000,000	
Paper-treating and paper-coating resins	23,000,000	
Bonding and adhesive resins for plywood	92,000,000	
All other bonding and adhesive uses	35,500,000	
Protective coating resins, straight and modified	22,000,000	
Resins for all other uses, including molding	95,000,000	
TOTAL		303,500,000
Vinyl resins		
All types, including chloride, saran, butyral, polyvinyl acetate		790,000,000
Styrene-type resins		
Molding materials	450,000,000	
Other types, including coating resins	220,000,000	
TOTAL		670,000,000
Alkyd and rosin modified coatings except phenolics		455,000,000
Coumarone-indene and petroleum polymer resins		235,000,000
Polyesters		100,000,000
Polyethylene		820,000,000
Miscellaneous types		180,000,000
GRAND TOTAL		4,157,200,000

[a] Source: U. S. Tariff Commission, first 8 months; last four months estimated
[b] Production figure used for all phenolics because of large proportion of captive plants

amount, depending upon how optimistic the producers are in estimating sales for the early part of 1959.

The sales figure should reach over 4 billion lb. unless November and December tapered off as severely as they did in 1957. Figures for alkyds and rosin-modified materials used as paint resins and recorded in the consumption column are uncertain at best since a great portion is produced in captive operations. Furthermore the phenolic-modified resins are reported under alkyds in the Tariff Commission's monthly report and under phenolics in the annual report and thus complicate the statistical picture.

The total amount of these alkyd and rosin-modified resins represents a total of from 400,- to 500,000 lb. and an error in this area could bring the total consumption figure down to 4 billion lb. or less.

Polyethylene moved into first position in 1958 from a volume standpoint when sales increased to over 800 million lb. and exceeded "all vinyls" by 20 or 30 million pounds.

Vinyl chloride was a little under last year in nearly all classifications, but a 30 million-lb. increase in floor covering resins brought the total up to almost a level with 1957. "All other vinyls," which includes vinyl acetate, alcohol, formal, butyral, and saran were well under 1957.

Polyesters showed big growth, going from 85 to 100 million lb., to justify the faith of those who put their trust in them 10 years ago. Increases in boats and glazing were instrumental in that growth.

The effect of the durable goods depression was felt particularly in the phenolic, vinyl chloride, methacrylate, nylon, and impact styrene classifications. Automobiles use at least 10 or 12 lb. of plastics per car, so that a drop in auto production of 1½ million cars was a severe blow. Appliances and furniture declines hurt these same materials. Perhaps a most favorable omen of the near future was a pick-up in home construction which increased to an annual rate of 1,330,000 in November from 1,260,000 in October. This means more plastic floor tile, house furnishings, decorative laminates, wiring and wire devices, stove hardware, refrigerators, and furniture for new houses in the near future.

Polyethylene and polyesters maintained their growth rate because users are finding new applications and expanded markets for materials that are still comparatively young.—END

Markets for materials—1958

Polyethylene

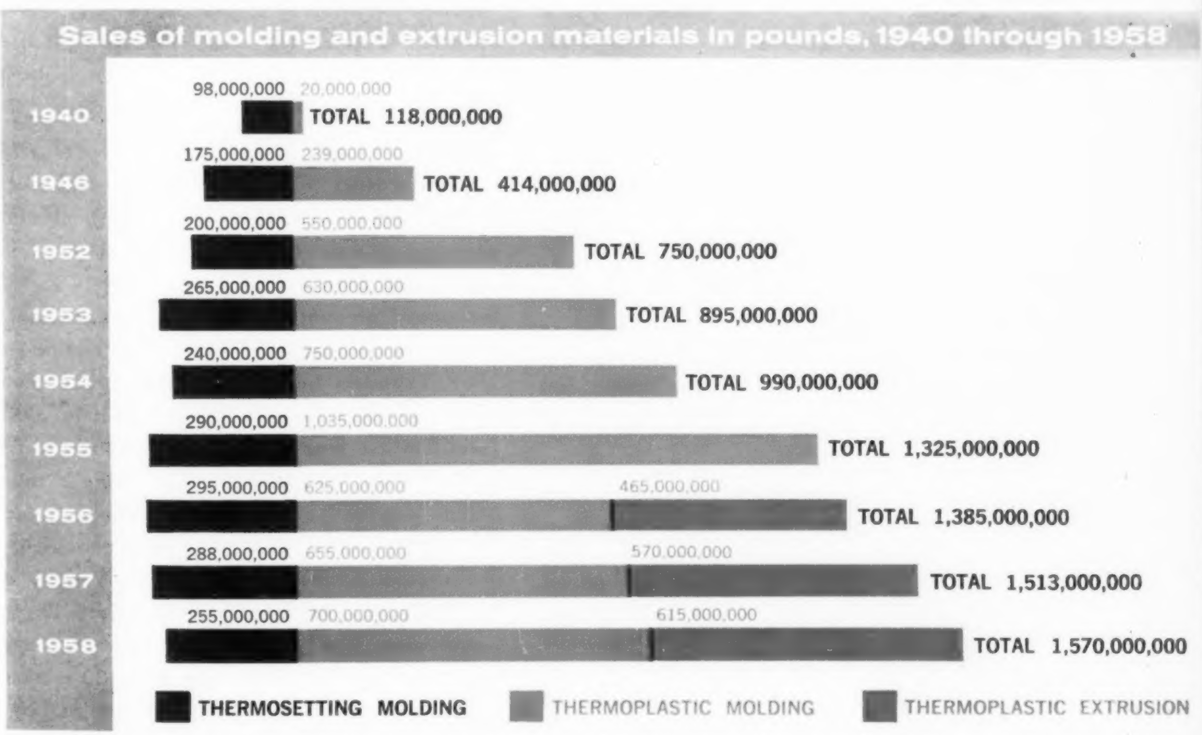
Polyethylene is now the champ!

While most other materials declined, or rose only slightly in 1958, polyethylene grew by around 160 million lb., or 25%, over the previous year. Polyethylene is largely responsible for the fact that plastics and synthetic resins consumption was larger in 1958 than in 1957.

Volume has grown at a rate of from 140 to 160 million lb. a year ever since 1955. The significant fact is that the poundage growth in 1958 was greater than in 1957. This increase would indicate that most markets are still expanding and new ones are being discovered. There was some feeling in 1957 that growth was beginning to level off since that year's increase was only 150 million lb. compared to about 160 in 1956, but 1958 was back up to a 160 million lb. increase again to allay that fear.

There are two significant factors in polyethylene's growth possibilities that require special consideration. One is the foreign market and the other is the position of low-pressure processed material, otherwise known as high-density or linear PE.

Exports of all polyethylene were 129, 190, and 230 million lb. in 1956, '57, and '58, respectively. This is equivalent to 28% of total production of 1958 and 25% in the two previous years. This is wonderful business while it lasts, especially since a large portion of off-grade material is shipped to foreign ports. But like rose petals that must fade from the bloom, this lovely business is likely to wither and fade. There are reportedly far more plants now in being or under construction in foreign countries than in



Includes extruded film, except cellulosic film. Includes fillers, except for vinyls. Thermoplastic extrusion figures do not include reprocessed material such as that used in pipe, garden hose, and film.
Figures are based on U. S. Tariff Commission reports, except for estimated last four months of 1958 and adjustments made in Tariff Commission Reports in "Miscellaneous molding" category.

the U. S. and they will eventually absorb a large part of that foreign market just as has happened with vinyl chloride. Some analysts expect exports to drop to 100 million lb. by 1961.

That 100 million lb. is still a good market; but the loss is going to be a shock when it comes. Of course American firms have a financial interest in several overseas plants, but they would still like to operate their American plants at close to capacity.

A sidelight to this foreign distribution is the Canadian situation. Canada is the largest importer of polyethylene even though two plants are now in operation there. The reason that is generally advanced is that Canada reexports the material to other countries in the British Commonwealth because of the easier quota factors.

The other factor not yet clear is the future position of high density polyethylene. Total capacity of linear polyethylene producers is scheduled at more than 300 million lb. by the end of 1959. On the other hand conventional or low-pressure capacity will probably be over one billion one hundred million lb. by the end of 1959 or sometime in 1960. At the present time consumption of conventional PE is almost equal to production and there were times in 1958 when the better grades of resin were close to becoming "scarce." Expansion by present producers of conventional PE is well under way and should keep ahead of demand under normal circumstances, especially in view of a prospective drop in exports and growing competition from other resins.

But the situation is quite different in high-density PE. Estimates on consumption of high-density PE in 1958 vary from 40 to 65 million pounds. Consumption in 1957 is estimated at under 10 million pounds. This is a serious situation for an industry that has announced construction of plants which have a capacity of over 300 million lb.

There are several reasons why this condition has arisen. In the first place when the discovery of the Phillips and Ziegler processes were first announced they were spread-eagled to the public with a fanfare that would have done credit to a Mike Todd extravaganza. The public became impressed with an idea that a miracle plastic was here at last. Producers of conventional PE were supposed to quake in their boots in fear of the new competitor. But the older producers refused to quake—they had the audacity to add capacity. And (*To page 76*)

1958 — the record

1959 — the prospects

POLYETHYLENE **Now the leading plastics in volume with sales of over 800 million pounds. Over 200 million of that poundage is exported. Linear polyethylene was somewhere between 40 and 60 million lb. of the above amount but new applications indicate it will be perhaps twice that amount in 1959. Extruders began more widespread production of chilled or quenched film from flat dies. Total film use was around 235 million pounds. Most of it was for packaging, but nearly 25 million lb. was for construction and agriculture, and at least 20 million more for miscellaneous purposes. Look for faster growth in these areas in the near future. Also watch for copolymer linear polyethylene film which should make exciting news in 1959. Molders used up to 100 million pounds. Trend toward more use of resins from 0.920 to 0.930 density depending upon application for which it is intended.**

VINYL CHLORIDE First year in which vinyl chloride resin volume failed to increase. Total slightly under 1957, but 30 million lb. increase in floor covering resins cushioned drop. Nearly all other applications were well under 1957, with exception of film which held about even. Wire coating resins now in a 70 to 80 million lb. volume declined slightly for the first time in vinyl history but wire coaters are working on small inventory. Other extrusions were down from effect of automotive decline. Unplasticized resin for rigid pipe and shapes begins to show evidence of growth. Plastisols still on the way up. Industry now has a billion lb. capacity but sales are only a little over 600 million lb. Price declines to 23½¢ a pound.

POLYSTYRENE Sales of molding material reached record high of around 450 million pounds. Copolymer and modified polystyrene are thought to be about 55% of the total. Impact material growing in use for housings such as television cabinets. Packaging uses continue to climb. Wall tile shows no sign of recovering from 2-year-old slump. Price for virgin material may have stabilized after two years of fluctuation—mostly downward. New styrene-methacrylate copolymer material was introduced at end of year.

CELLULOSICS General decline in all classifications, including thin film, except sheet which benefits from increased use of vacuum forming. Development of automatic blister packaging machine for small items produced in million lots should help film and sheet volume. Molding material rapidly taking over the hand telephone market.

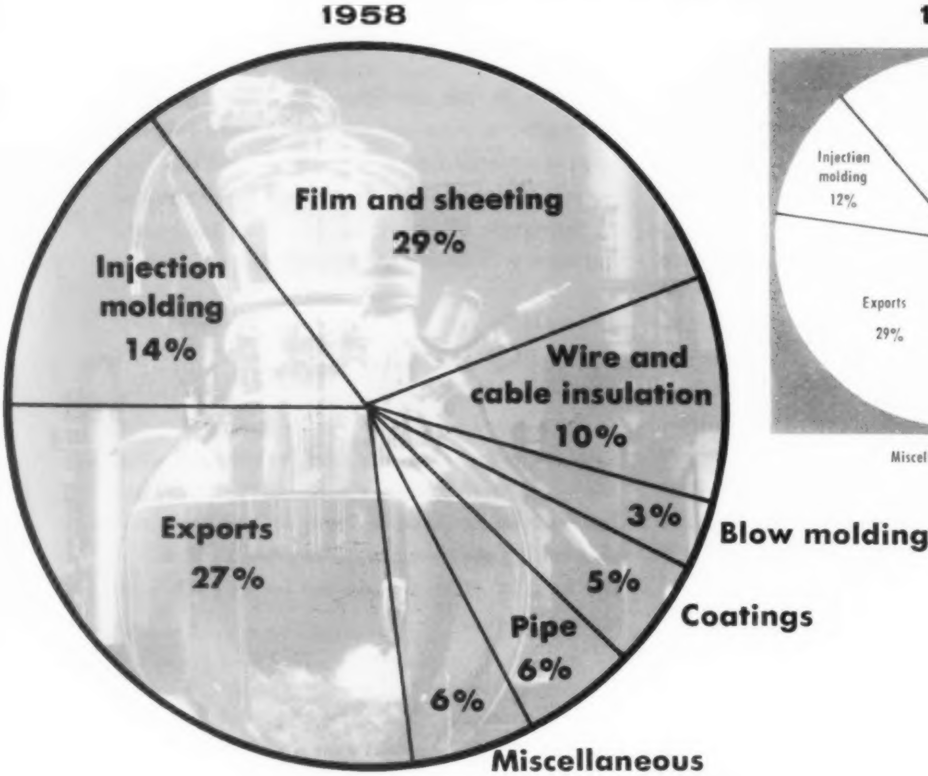
METHACRYLATE Market affected by decline in automobiles which use almost 2 lb. per unit. Sheet for signs, glazing, etc. seems to grow steadily but in small volume. Impact material now in shoe-heels and markets where its non-staining properties are valuable. Methacrylate sirup gaining headway for bonding resin with fibrous glass in reinforced plastics.

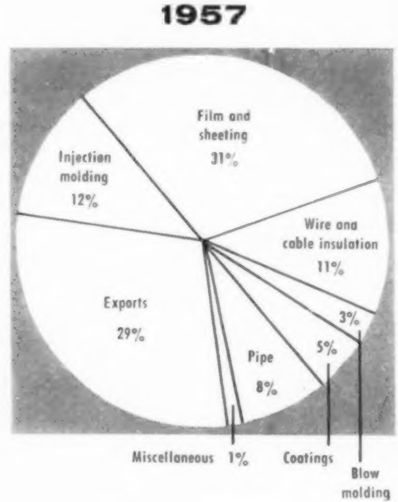
NYLON Beginning to show signs of volume use in consumer items such as roller skates, sports helmets, marine hardware. Bottles remain a likely future product. Automobiles continue to use more nylon per car with tubing showing particular promise. Industry still hopeful of finding market for nylon film in sizable volume.

PHENOLICS Molding powder down from 180 million in 1957 to 161 million in 1958. Price reduced in mid-year. Third largest producer quits production of molding material. Industry expects to get back up close to 200 million lb. as it was 3 years ago. Liquid phenolics were also down in 1958 due to decline in general business. Decorative laminates now consume more than half of resin used for laminating. Experimental work on resin for use in missiles may develop formulations that will find way into commercial applications.

UREA AND MELAMINE Continued increase in production of melamine tableware is bright spot in keeping total urea and melamine molding material up around 90 million lb., but other uses for melamine molding material have not grown appreciably. Melamine for decorative laminates is around 20 million pounds. Wire devices and closures or containers largest items for urea—buttons on the other hand, have declined. Urea glue benefits from huge and growing production of particle board and other forms of waste-wood bonding.

Estimated polyethylene consumption by end uses





Estimated consumption of polyethylene, by end uses[a, b]

End Use	1954 lb.	1955 lb.	1956 lb.	1957 lb.	1958 lb.
Film and sheeting	70,000,000	120,000,000	160,000,000	205,000,000	235,000,000
Injection molding and profile extrusion	34,000,000	45,000,000	50,000,000	80,000,000	110,000,000
Wire and cable insulation	29,000,000	45,000,000	58,000,000	75,000,000	85,000,000
Pipe	22,000,000	26,000,000	35,000,000	50,000,000	50,000,000
Coatings[c]	20,000,000	30,000,000	30,000,000	35,000,000	42,000,000
Blow molding[d]	7,000,000	9,000,000	15,000,000	20,000,000	28,000,000
Exports	12,000,000	65,000,000	125,000,000	190,000,000	230,000,000
Miscellaneous	13,000,000	10,000,000	41,000,000	7,000,000	40,000,000
TOTAL	207,000,000	350,000,000	514,000,000	662,000,000	820,000,000

[a] These figures do *not* include reprocessed material that is used in pipe, molding material, black film or exports, but they *do include* off-grade resins which are reported by suppliers as virgin material and are used primarily for pipe, molding and export. [b] Total figures are based on Tariff Commission reports, except 1958, which is estimated. All other figures are MODERN PLASTICS estimates. [c] Includes wax used for coatings. [d] Includes bottles, jars, carboys, toys.

the new material has had a tough time trying to break into the market.

It didn't take long to discover that the new polyethylene was another plastic rather than just more polyethylene. It was made from the same raw material but required different techniques in handling than conventional PE. It had properties, such as stiffness and heat resistance, that were superior to the older PE, but in many applications it didn't have the toughness and flexibility desired. Processors discovered that they needed different equipment and new molds to handle it. And processors were loath to spend money in the rough year of 1958 for new tools. And despite the claim that it was a potentially lower cost material, its list price is 8¢/lb. more than the most widely used grades of conventional PE. Furthermore it is now faced with competition from another polyolefin, polypropylene, which will compete in many

applications that are now claimed for linear polyethylene.

But there is now a brighter side to the picture. The several years needed for development work, necessary in every plastic ever discovered, have now been spent. The year 1958 may well go down in plastics history as the time when linear PE really made its start. There have been few if any plastics that ever jumped from less than 10 million lb. to 35 or 40 or more in what is virtually its first year of full-scale commercial production.

The reason for optimism is that dozens of projects using linear PE are just beginning to get started. After a halting start by housewares molders who finally recognized that they had to have new molds, there are now several lines on display. The new Pan-American overnight bag completely molded in linear PE is an example of an application never tried before in plastics. Molders are finding ways to broaden their markets with this material because of its toughness, surface gloss, and heat resistance. Bottles are almost a cinch to become big volume. Monofilaments for rope, woven upholstery tape, and fabric are already established.

Perhaps the most encouraging of all is in film where development had been slow and disappointing. But a copolymer resin with butene generally used as the second monomer is giving good results in experimental runs. The copolymer improves strength in both directions and will probably be extruded by either the quenched or chilled roll method since it loses clarity when the tubular method is used. This may turn out to be the most important development recorded for linear polyethylene since it came to market.

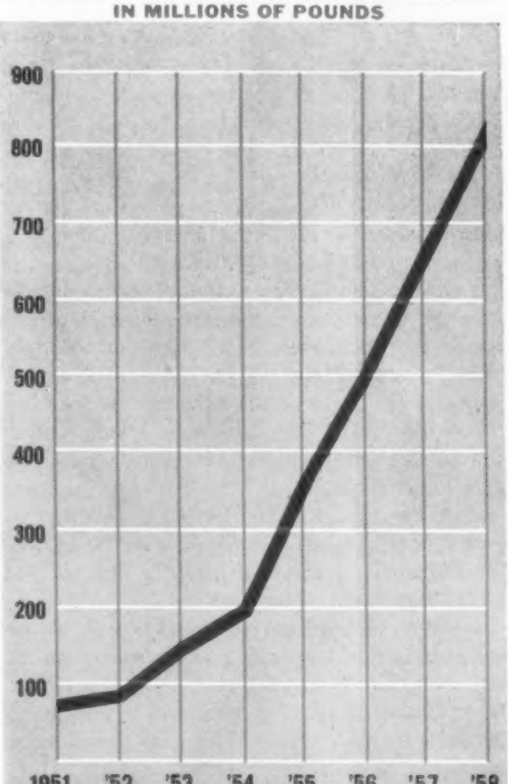
There are no accurate statistics to determine how uses for linear PE were divided in 1958 but one estimator guesses the following pattern: Molding, 8 to 10 million lb.; monofilament, 3 million; export, 15 million; bottles, 1 to 2 million; pipe, 1 million. There was a good lot used for experimental purposes, and a considerable amount used for blending with conventional PE to obtain a higher density material. The much talked about Hula-hoop required from 12 to 15 million pounds. This latter was mostly off-grade, but hoop manufacturers were so eager that they would buy anything available including first grade material. The demand for this item in late summer is said to have cleaned out the inventories of every producer.

Film and sheet was as usual the largest volume user of polyethylene in 1958. Of the estimated 235 million lb. of film produced in 1958 it is thought that from 170 to 175 million was used for packaging. Around 10 million was used for drapes, table cloths, and other fabric purposes. More than 3 million of this amount may have been calendered. The construction industry is estimated to have used 15 million in comparison to 12 million in 1957. Agricultural uses may have doubled in 1958 from a low of 3 or 4 million in 1957. The rubber industry is estimated to have used 5 to 7 million lb. for camel back and as a separator to prevent rubber from sticking in the tire-manufacturing process. In the miscellaneous category there are such items as balloons, glazing, temporary seat covers for automobiles, and a few million lb. for sheeting used in thermoforming and drums or drum liners.

Several uses for PE film promoted in 1958 are expected to become extremely large volume in the next few years. One was in a complete PE bread wrapper but the amount used in '58

Polyethylene Sales Growth

IN MILLIONS OF POUNDS



may have been even less than the amount of paper used to promote its virtues. Several bakeries are testing the possibilities of a combination PE-waxed paper wrapper. At present it is being suggested largely as a competitor to cellophane for wrapping specialty breads that command a premium price, but the goal is to eventually take over a large portion of the waxed paper wrapper. Incidentally there is a fair amount of low-molecular-weight polyethylene used in those same waxed paper wrappers.

Another contender for big volume introduced in 1958 was a 10-mil-thick PE bag to be used for fertilizer, feed, seeds, and other bulk commodities that must be protected from moisture. It would compete with multiwall bags. The cost problem has not yet been licked.

The third item is a film for cigarette packages. One producer envisions it as made from high-density resin which is oriented in one direction only and would tear easily in the transverse direction, thus giving a built-in tear tape.

If all three of these items were to be produced in PE film the total poundage needed could be several hundred million pounds. The industry won't give up easily on these ideas.

An increasing interest in the use of higher density films was prevalent during the year. Practically all film was once made from 0.917 or 0.918 density resin but there is now a trend toward 0.928 or the higher priced 0.930 medium-density material in order to obtain more clarity and stiffness.

Another matter of interest in PE film was more wide-spread development of extrusion by water bath or chilled roll methods, as opposed to tubular or blown film. Paper coaters are particularly interested since they can use much of the same equipment now employed in paper coating. Chilling the film immediately after it comes from the extruder will help to give clarity. There is still some dispute whether the chilled roll or quenching by water bath is the more practical but the former seems to be gaining ground. Blown film is faster at present and produces a tougher film but the flat extrusion processes named above may be the answer for those who want to produce a film for flat wrapping.

Injection molding moved ahead largely on the strength of an increasing housewares business, although the toy market also expanded. About 60 or 65 million lb. of virgin resin is thought to be used in housewares. There is also a good sized-quantity of reprocessed material used here which is not reported in the Table on p. 76.

There has been considerable maneuvering in this area as the price fluctuated between 32 and 35¢ for a resin with a high melt index that is used largely for housewares moldings of large size. Some producers claimed there had been sniping at the standard 35¢ price by competitors who were purportedly selling standard grade material at the price of off-grade. Consequently they lowered the boom on so-called price slashing.

The figure of 28 million lb. for blow molding in 1958 will be disputed by many readers but this item includes blow-molded toys as well as bottles, tubes, and jars. Toys made by this method are potential big volume but their competitive position in regard to other plastics toys is not yet clear. The use of squeeze bottles and metal-end tubes (cans) is *(To page 163)*

Vinyl chloride

A consumption figure of 625 million lb. compared with a capacity of somewhere near a billion lb. of vinyl chloride polymer, plus the fact that 1958 will probably be the first year in history when vinyl chloride consumption did not increase over the preceding year, has doubtlessly created some gray hairs among executives in the vinyl chloride business.

This situation brings to mind the statement of the president of Marshall Field who, when speaking at the first S. P. I. meeting in Chicago after World War II, said something like this: "The more material you have, the more difficult it will be to sell."

There are now 20 companies producing vinyl chloride polymer and Air Reduction is about to join the group with a new plant at Calvert City, Ky., to make it 21. The new facility is a joint venture with Mastic Tile, Albany, N. Y., who is a major producer of floor tile. At least 10 of these 21 are captive companies—that is, they produce primarily for their own use; but in each case they also have a surplus to put on the market. They are producing general-purpose resin usually intended for either calendering or extrusion. Higher-cost resins, such as those for plastisols and unplasticized compounds, are still largely in the hands of a few of the older producers. During the summer the price of general-purpose resins was dropped from 27 to 25¢/lb., and was re- *(To page 80)*

PRICE HISTORY OF PLASTICS MATERIALS*

POLYETHYLENE

YEAR	L-D PRICE $/lb.	H-D PRICE $/lb.
1943	1.00	
1944	1.00	
1945	0.70	
1946	0.52	
1947	0.47	
1948	0.43	
1949	0.43	
1950	0.45	
1951	0.48	
1952	0.47	
1953	0.47	
1954	0.41	
1955	0.41	
1956	0.41	
1957	0.35	0.47
1958	0.35	0.43

TEFLON

YEAR	PRICE $/lb.
1944	15.00
1948	9.00
1949	7.50
1950	5.50
1954	5.10
1955	4.90
1956	4.50

PHENOLIC

YEAR	PRICE $/lb.
1925	0.60
1931	0.22
1933	0.14
1941	0.155
1943	0.135
1946	0.155
1947	0.165
1948	0.172
1949	0.167
1950	0.197
1954	0.187
1955	0.192
1956	0.202
1957	0.212
1958	0.192

PROPIONATE

YEAR	PRICE $/lb.
1956	0.62

POLYVINYL CHLORIDE

YEAR	PRICE $/lb.
1934	0.78
1935	0.59
1936	0.59
1937	0.56
1938	0.56
1939	0.56
1940	0.52
1941	0.52
1942	0.48
1943	0.44
1944	0.39
1945	0.35
1946	0.33
1947	0.33
1948	0.34
1949	0.34
1950	0.36
1951	0.38
1952	0.38
1953	0.39
1954	0.37
1955	0.35
1956	0.32
1957	0.30
1958	0.235

NYLON

YEAR	PRICE $/lb.
1944	1.60
1955	1.435
1956	1.33
1957	1.18

BUTYRATE

YEAR	PRICE $/lb.
1938	0.70
1939	0.54
1940	0.49
1944	0.44
1946	0.56
1949	0.51
1950	0.62

EPOXY

YEAR	PRICE $/lb.
1953	1.00
1954	1.00
1955	0.80
1956	0.80
1957	0.80
1958	0.62

POLYSTYRENE

YEAR	PRICE $/lb.
1938	0.68
1939	0.60
1940	0.58
1941	0.58
1942	0.29
1943	0.29
1944	0.27
1945	0.27
1946	0.29
1947	0.24
1948	0.26
1949	0.24
1950	0.27
1951	0.32
1952	0.32
1953	0.32
1954	0.31
1955	0.30
1956	0.30
1957	0.27
1958	0.25

UREA

YEAR	PRICE $/lb.
1944	0.22
1947	0.29
1948	0.30
1949	0.31
1950	0.33
1957	0.34

MYLAR

YEAR	PRICE $/lb.
1951	3.00
1954	2.85
1955	2.50
1956	2.25
1957	2.00
1958	1.80

MELAMINE

YEAR	PRICE $/lb.
1947	0.45
1948	0.48
1950	0.45
1956	0.45
1957	0.47

ACETATE

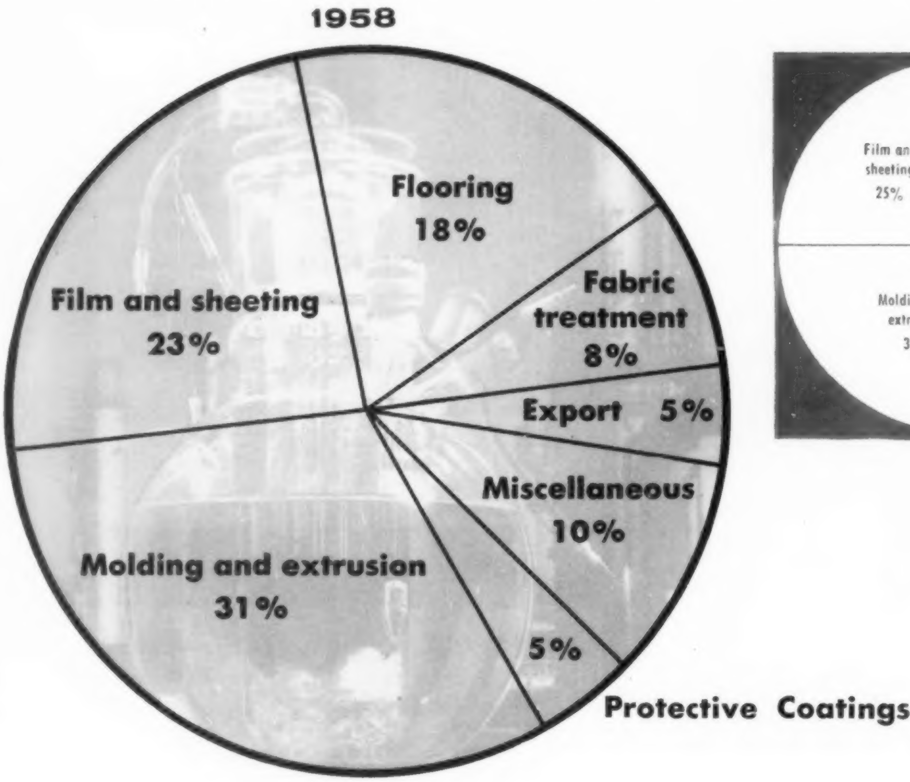
YEAR	PRICE $/lb.		
	Group I	Group II	Group III
1948	0.47	0.42	0.33
1949	0.47	0.42	0.35
1950	0.49	0.43	0.37
1951	0.57	0.50	0.42
1952	0.57	0.50	0.42
1953	0.50	0.46	0.42
1954	0.50	0.46	0.42
1955	0.50	0.46	0.36
1956	0.50	0.46	0.36
1957	0.50	0.46	0.38
1958	0.52	0.48	0.40

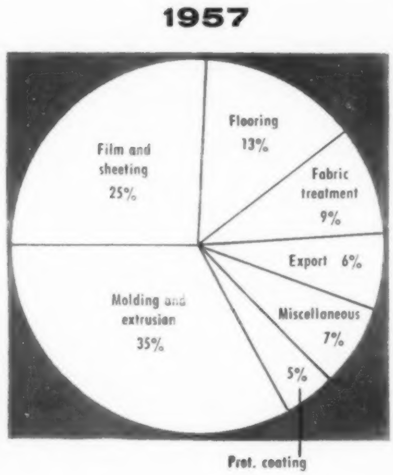
METHACRYLATE

YEAR	PRICE $/lb.
1937	0.85
1947	0.70
1954	0.68
1955	0.59
1956	0.55

* Only years given when price change is made, except phenolic which skips several years in the late 1920's when prices were declining. Prices are based on lowest quotation for quantity lots. When comparing prices of one plastic with another, reader must consider specific gravity.

Consumption of polyvinyl chloride and copolymers





Polyvinyl chloride and copolymer consumption 1954-1958[a]

Use	1954 lb.	1955 lb.	1956 lb.	1957 lb.	1958 lb.
Film under 10 mils	69,000,000	83,000,000	78,000,000	78,000,000	77,000,000
Sheeting 10 mils and over	55,000,000	51,000,000	53,000,000	80,000,000	65,000,000
Fabric treatment[b]	42,000,000	56,000,000	55,000,000	55,000,000	48,000,000
Paper treatment	7,000,000	8,000,000	8,000,000	10,000,000	9,000,000
Floor coverings	34,000,000	56,000,000	66,000,000	82,000,000	112,000,000
Molding and extrusion	148,000,000	183,000,000	205,000,000	220,000,000	197,000,000
Protective coatings	23,000,000	26,000,000	29,000,000	32,000,000	32,000,000
Miscellaneous[c]	34,000,000	58,000,000	74,000,000	78,000,000	85,000,000
TOTAL	412,000,000	521,000,000	568,000,000	635,000,000	625,000,000

[a] First three years are based on U. S. Tariff Commission reports, with estimated alterations necessitated by more varied classifications. Figures for 1957 are partially estimated because of errors made by companies in reporting to Tariff Commission. Figures for 1958 are all estimated for last 4 months.
[b] Resin used for laminates with fabric is included in film figure rather than in fabric treatment.
[c] Includes an estimated 30 million lb. of resin for export including that used in compounds.
Note: Film and sheet resins are impossible to separate accurately but the total of the two as given above is thought to represent a reasonably reliable figure on total amount of resin used for both.

duced further in December to 23½¢, with the explanation that it was due to competition from imported resins and was forced on an industry where capacity is running far in advance of consumption. The 25¢ price was far from firm. Even with the lower price, occasional price slashing may occur and is to be expected in a period of slack sales and overcapacity.

Total imports, according to Census Bureau records, were only about 12½ million lb. in 1958, compared with a little over 13 million in 1957. This is not enough to make a serious dent in consumption of domestic resins running at over 600 million lb., but still enough to create exaggerated rumors of its potency. The big market potential for low-cost foreign resins has

been punctured in the calendering business because so many calender operators are now producing their own resin; but some of the compounders and other users are still buying it. It is also more difficult for imports to compete on a cost basis now that the base price in the United States is 23½ cents. However, customers claim that they are buying Japanese resin at well below that price. Of the 12½ million lb. imported in 1958, 6 to 7 million came from Italy compared with over 11 million imported from that country in 1957. Japanese sales of vinyl chloride resin in the U. S. in 1958 were probably 4 to 5 million lb., compared with 1.4 million in 1957. The balance of the imports come from various countries, primarily Canada. Additional imports include some 2 to 3 million lb. of patent vinyl sheeting, which has invaded the pocketbook field.

The leveling off of vinyl chloride production in 1958 was not unexpected in view of the general economic decline in durable goods. The wonder is that it was not worse. There are several interesting aspects in this situation. Vinyl is such a good utilitarian material that a depression in durable goods was not fatal; its wide-spread use in consumer goods helped to soften the blow in durable goods.

Another interesting fact, pointed up by the table on p. 80, is that consumption was down by a small percentage in almost every end-use classification, but a tremendous upsurge in the use of resin for floor-coverings compensated for nearly all these losses. Without the increase of around 30 million lb. in floor covering, vinyl chloride would have been down 30 to 40 million lb. in 1958 compared with 1957. Scarcely a year goes by that this phenomenon of an upsurge in one or two big markets is not repeated. New and expansion-of-old uses keep vinyl on the march. It has by no means reached the age of maturity. A billion-lb. consumption rate by 1963 or 1964 is not an impossibility; but the industry will have to grow faster than it has in the past four years in order to make that goal possible.

In the meantime, price stability is by no means assured. When capacity is running several hundred thousand pounds a year ahead of consumption something is going to give and that something is likely to be price, which in turn means less profit and possibly retirement from the business by companies who get squeezed in the profit picture. Another possibility is that companies who produce their own resin for fabrication purposes may eventually

PATTERN OF CONSUMPTION OF CALENDERED VINYL FILM*

Uses	1953 lb.	1957 lb.	1958 lb.
Draperies, bedspreads, kitchen and bathroom curtains	23,000,000	14,000,000	13,500,000
Yard goods	10,000,000	6,000,000	4,000,000
Adhesive-backed film	—	6,000,000	5,500,000
Closet accessories	6,500,000	6,500,000	6,900,000
Shower curtains	6,000,000	8,800,000	9,200,000
Nursery goods	4,000,000	5,000,000	3,800,000
Baby pants, liners	2,400,000	4,500,000	6,000,000
Table covers	4,000,000	3,000,000	3,000,000
Appliance covers	3,000,000	3,000,000	2,100,000
Furniture covers, indoor and outdoor	3,000,000	3,000,000	4,700,000
Rainwear and sportswear	10,000,000	9,000,000	11,000,000
Aprons, including industrial	1,500,000	2,500,000	1,800,000
Lamination, quilting	—	15,500,000	11,500,000
Wall covering	—	4,500,000	2,500,000
Industrial tape	—	7,000,000	6,000,000
Inflatables	—	6,500,000	7,500,000
Industrial, agricultural, and miscellaneous	20,000,000	9,200,000	21,000,000
TOTAL[a]	93,400,000	114,000,000	120,000,000

*This table is intended to include only products made of calendered film up to 10 mils in thickness. Everything 10 mils or over is classified as sheeting. However, it is impossible to eliminate a certain amount of overlapping between film and sheeting and between various classifications of products given above. The figures are given as approximations to show trends. Accurate statistics are not available. See text for discussion.

[a]This does not include film made from imported resin, but it does include that made from resin which is not reported to the Tariff Commission.

VINYL CHLORIDE FOR MOLDING AND EXTRUSION

Application	1957 lb.	1958 lb.
Phonograph records	35,000,000	35,000,000
Slush and elastomeric molding	45,000,000	37,000,000
Garden hose	7,000,000	7,000,000
Profiles	38,000,000	30,000,000
Wire coating	85,000,000	77,000,000
Rigid pipe and shapes	10,000,000	11,000,000
TOTAL	220,000,000	197,000,000

find it less costly to buy resin than to make their own.

If the industry is to continue to grow at a greater rate than the population, it will probably have to depend largely on new applications and new or improved resins. One of the most promising situations is in widespread use of unplasticized resins for pipe and structural applications. A new window-frame, for example, already looks most promising along this line. Roofing, downspouts, gutters, and housings are other potentials, but their full realization is several years away. An unplasticized vinyl film may soon develop into a modest poundage volume. An unplasticized sheet was exhibited at the Plastics Show as a special development for blister packaging. Improvements during the past year included a rigid resin that is claimed to extrude much easier than anything previously offered and a resin for transfer molding that enables vinyl resin to be used in many applications where it was formerly impractical.

Other growth possibilities are in plastisols, coatings, and an extruded foam from a standard resin which made its debut in 1958 as a wire-coating material. Spread-coating of plastisols on steel for station wagons interiors looks like a definite large-volume application in the near future. Production of resin for plastisols and organosols is estimated at a rate of 70 to 80 million lb. a year. There was little growth in 1958 because of a decline in spread-coated automotive and furniture applications. Vinyl chloride solution-coatings on aluminum for outdoor use and even a general-purpose self-priming coating that can be applied to old painted surfaces are other possibilities with big futures. The skin for automotive crash pads made from a formulation containing vinyl and other materials is still another new product; and a new floor tile laminate with the top layer reverse printed will add thousands of pounds to the floor-covering market.

Vinyl is probably the most versatile of all thermoplastics and therefore its possibilities for growth must never be discounted. It is the one thermoplastic that can be compounded and modified and buried in a multitude of applications where its properties serve to improve the original product. As little as 15% vinyl can be added to the end product to achieve a superior material. An example is vinyl-asbestos floor coverings, a product that has had sensational growth in the last three years and is still climbing. This marriage of vinyl to other materials is a feature of the plastics industry that has not had nearly enough attention and should account for millions of pounds of volume in the next 10 years.

The above are only a few of the new products that the industry is relying upon to build big new markets in the future. However, such new products must also absorb some of the losses in older products and make up as well for those whose growth has slowed or ceased. For example, polyethylene has moved into the drapery and tablecloth market and has slowed down the growth of vinyl agricultural uses; tarpaulins and wall coverings have not grown as much as expected. The export market, too, has declined, which example should serve as a warning to makers of other plastics that are now blessed with huge export tonnages.

The slight decline in vinyl consumption in 1958 as shown in the Table on page 80 could be charged off to the drop in automotive production in 1958. This drop was around 1.5 million cars compared with 1957 output. Vinyl consumption is estimated at 8 to 10 lb. per car. At that rate automotive consumption of vinyl chloride would be down 12 to 15 million lb. in 1958. This loss is distributed through almost every end use classification, except floor covering which was unaffected by the automotive decline.

The first six months in 1958 presented a rather gloomy picture, but business started to pick up in May and every month since then has exceeded 1957, with a rousing 60 million lb. in September—which was far ahead of any month on record. The previous high was 58 million lb. in October of 1957. These figures are taken from

the Tariff Commission's monthly reports and are always subject to upward adjustment when the annual reports are published, but they do indicate a trend. This trend shows that consumption in the last half of 1956 was 295 million lb.; it was almost the same in 1957; and it may run from 315 to 322 million lb. in 1958—which is certainly a most encouraging situation. However, December has been traditionally a very low month for vinyl, and if it should drop back again to 40 million lb. or so in 1958, sales managers would certainly cry in their beer. It is hard to believe, however, that a drop from 60 million lb. in both September and October to 40 or thereabouts in December 1958 could occur.

The largest classification in the Table on p. 80 is the "molding and extrusion" category. It also creates the biggest headache when one tries to separate it into its various component parts. The figures given in the Table on p. 82 are certainly subject to challenge, but they are the best that can be obtained from personal interviews with various companies. The reasons for this are: a cagey attitude by some producers who do not want to show their hand; difficulty in determining what a customer may do with some types of resins; and faulty reporting to the Tariff Commission which may result in certain resins being listed as for extrusion purposes when they should be in miscellaneous or vice versa.

Wire and cable coating has always been the highest volume use in the various classifications listed in the Table on p. 82. The first half of the year was almost 20% under the same period in 1957. The drop in automotive production, with each car using perhaps 2 lb. of vinyl for wire coating, cut heavily into this market. A good last quarter was expected but not enough to bring the total poundage up to 1957.

Extruded foam over wire is expected to add big volume in the near future. This extruded foam is made with a blowing agent using air as a filler. It can even be extruded over thread as a carrier and may find use for cushioning as well as insulation. An electrical grade plastisol that may be used for either dipping or coating was also introduced in 1958—it has low moisture absorption and high volume resistivity—and is suggested for nylon-jacketed wire, spaghetti-type applications, and for cables normally coated with asphalt.

Next largest volume in this classification is slush and elastomeric molding. The latter is used for handles on lawnmowers and bicycles, handles and end pieces on (*To page 158*)

Polystyrene

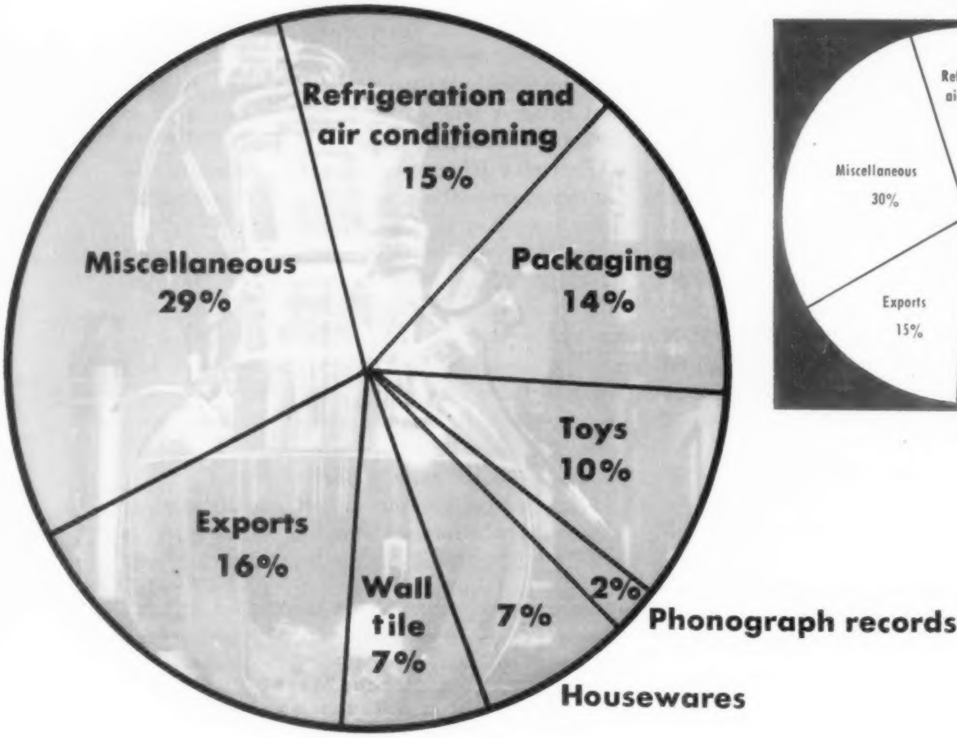
Trying to guess what the actual polystyrene molding volume was in 1958 is as difficult as trying to guess what it will be in the year 2000. Estimates for the past year are far more controversial than they have ever been before and range all the way from 435 to 485 million pounds. A recent independent survey of molders indicates that their activities would require

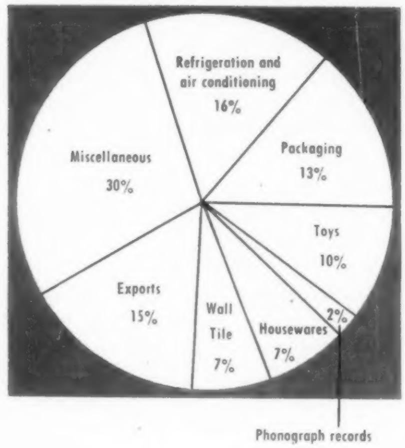
Miscellaneous Polystyrene Products[a]

Radio cabinets	Photo equipment	Bar supplies and stirrers
Lighting fixtures	Dental plates	Toilet seats
Toiletries	Jewelry	Cigaret lighters
Monofilaments for brushes	Baby equipment	Vacuum cleaners
Molded furniture drawers	Window shades (pullers and Venetian blinds)	Fishing equipment
Novelties and premiums	Small appliance parts	Film for packaging and laminating
Office equipment	Clothes pins	Sheet for packaging, lighting, signs, etc.
Seasonal decorations (Christmas ornaments)	Recording tape spools	
Pipe and fittings		

[a] Breakdown by products of percentage shown in pie chart on p. 84.

Molded and extruded polystyrene products





Styrene-type resin sales, 1954-1958[a]

Use	1954 lb.	1955 lb.	1956 lb.	1957 lb.	1958 lb.
Molding and extrusion materials[b]	309,000,000	386,000,000	402,000,000	429,000,000	450,000,000
Protective coating resins[c] (straight and modified)	80,000,000	94,000,000	93,000,000	85,000,000	92,000,000
Resins for other uses[d]	68,000,000	92,000,000	108,000,000	133,000,000	128,000,000
TOTAL	457,000,000	572,000,000	603,000,000	647,000,000	670,000,000

[a] Source: U. S. Tariff Commission, except 1958, which is estimated.
[b] Includes plasticizers, fillers, and extenders; modified and copolymer molding or extrusion materials; resin for foam made from beads but not that sold in expanded form which is reported in "Resins for other uses."
[c] Includes high styrene-butadiene resin for latex and paper treatment; also resin for styrenated alkyds.
[d] Includes high styrene-butadiene rubber reinforcing resins; ion exchange resins; polystyrene used in floor coverings; metal treating resins and prefabricated polystyrene foam.
Note: Totals for "protective coatings" and "resins for other uses" have been intermingled in company reports to Tariff Commission prior to 1958. Therefore they can be used only to indicate trends in each category but when added together are reasonably accurate for a total of all styrene-resins other than molding material which is listed in top line of table.

a volume far above the 450 million lb. listed in the Table above. An interesting aspect of this molders' survey is that it shows a much higher poundage for toys than an analysis made by MODERN PLASTICS, which depended primarily upon estimates that were submitted by raw material suppliers.

The total listed in the Table is based on Tariff Commission monthly reports through September, adjusted to take care of the companies who have not reported monthly but will give their total 1958 production and sales figures when the Tariff Commission prints its annual report in 1959.

Strangely enough, there seems to be no particular glee among either producers or molders about this nice increase over 1957. This despite the fact that, except for polyethylene and poly-

ester, polystyrene was the only major plastic to show an increase in the year's business in 1958. The answer may be that profits have declined because of the price situation even though sales have gone ahead.

Another observation is that producers' inventories of resin, which had been piling up for several years, were reduced in 1958 and that some of the off-grade material previously used in asphalt floor tile was finding its way into utility black molding material. Heretofore this resin had been generally reported as "resins for other uses" and didn't get into the molding material figure.

In any case polystyrene molding material made a remarkable record in 1958 compared to most other plastics, and most any other material for that matter. Furthermore, the increase developed without the impetus of any particularly new, large-volume application and despite a price situation that has created ups and downs in the buying pattern ever since the monomer price contract with rubber companies was announced two years ago. During the past year and a half there has also been considerable price maneuvering while companies jockeyed to meet various discount systems.

The first major price decline in this period was in September 1956, when general-purpose material dropped from 30½ to 27½¢/lb. after announcement of the monomer agreement with rubber companies. There were then two more price drops in the summer of 1957 to bring the level to 25 cents. It came down again in February 1958, to reach 24½¢.

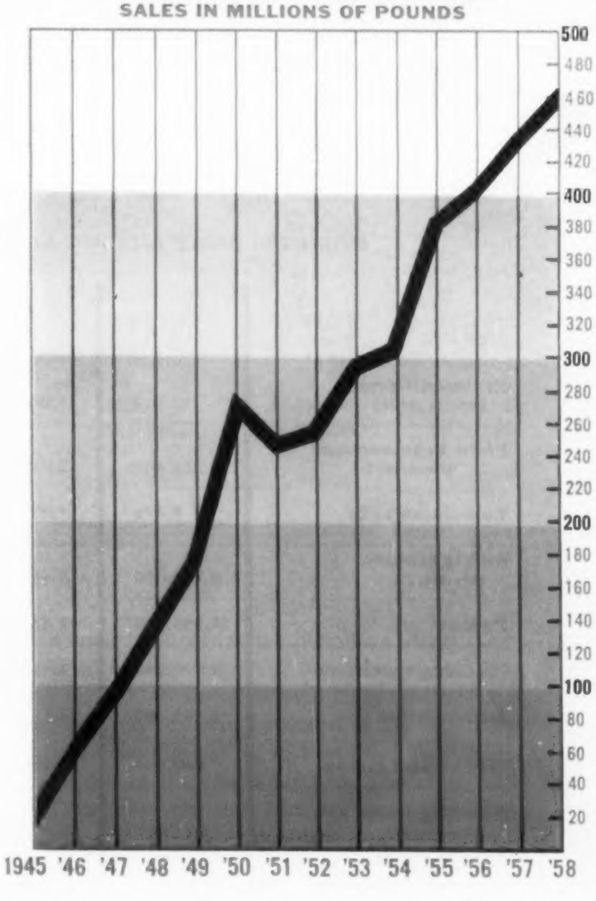
Nearly every time a price reduction was announced there was a two or three months' delay before it went actually into effect. During those periods, molders delayed buying in anticipation of a decline. Immediately following the effective date of the reduction, they bought in more than the usual quantity. Another buying pattern involved purchasers taking advantage of a discount which was to be eliminated a month or two later. Accordingly the volume trend by months for the last two years is not a true pattern of the marketing picture. For example there was a 42 million lb. (record) month in May but it was followed by two low months of 33 and 30 million, as molders had built up their inventory.

A new entrant in the field during 1958 also enlivened the situation: Cosden Petroleum started production in a 21-million lb.-capacity plant, using a new process which eliminates one step in manufacturing operations and consequently could affect pricing. Cosden established a new price system based on location of the customer in relation to the company's plant in Big Spring, Texas, and original quotations were from 1½ to several cents lower than standard prices, depending on where delivery was made. The company is using specially built trucks that will carry 35,000 lb. of material which is unloaded in bulk by a pressure process. But the company is selling only two grades of material—general-purpose and impact in natural color.

Another company the industry is eyeing with interest is Shell Chemical which operates a monomer plant in California. Shell officials are not talking on the possibility of their entering the polymer field but there is curiosity concerning what they will make in a plastics plant

STYRENE-TYPE MOLDING MATERIAL

SALES IN MILLIONS OF POUNDS



which is supposedly to be erected in New Jersey. Samples of Shell polystyrene molding material have reportedly been circulated among molders but their appearance is no guarantee that commercial production will follow. Shell is a cautious company—it doesn't enter a new enterprise without careful preparation.

Reichhold has also announced that it will soon start producing all varieties of plastics, which would supposedly include polystyrene.

The use of impact molding and extrusion material is continuing to attract major attention in the industry. The price structure of these materials has been quite stable. Estimates for the amount of medium and high impact consumed in 1958 vary from 145 to 175 million lb. with 5 to 8 million more in super-impact. It didn't grow as much in 1958 as in 1956 and 1957. One reason was that refrigerator sales were down about one-third in the first half of 1958; and refrigerators are a major market. The fact that it grew at all, however, is encouraging as an indication that it is moving into other markets. Housings for television and portable sewing machines are new applications that show the trend and something like ¼ million lb. for furniture drawers could be the beginning of a big new market.

Estimates on the amount of styrene copolymer resins consumed in 1958 vary from 40 to 50 million pounds. One estimator thinks there was about 30 million lb. of ABS (acrylonitrile-butadiene-styrene) and 20 million lb. of the acrylonitrile-styrene variety. The ABS type is divided between Kralastic and Cycolac with the former thought to be well over half. This would include 5 or 6 million lb. for pipe, a small amount for miscellaneous molded items, and the balance for sheet, including Royalite and Boltaron. Cycolac has moved substantially into several fields including artillery shells, airline trays, appliance knobs, (*To page 164*)

Cellulosics

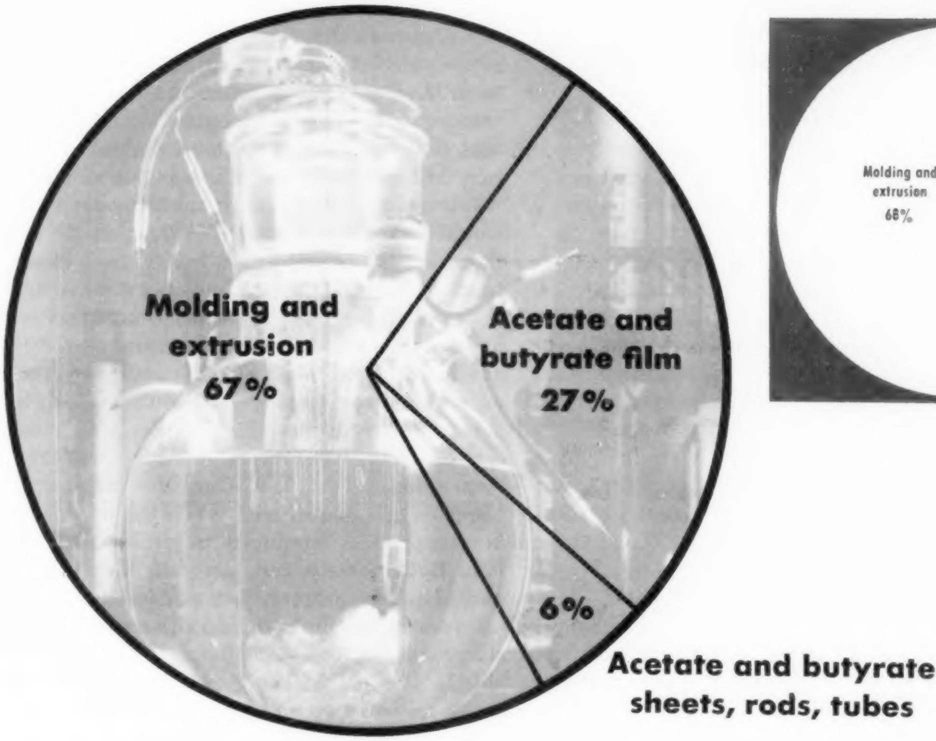
For the first time in several years there was nothing particularly new in the cellulosics to pep up sales or create new markets. The impetus given in former years by such items as shoe heels, extruded film, vacuum forming, pipe, and new formulations was missing in 1958. This plus a declining economy resulted in a

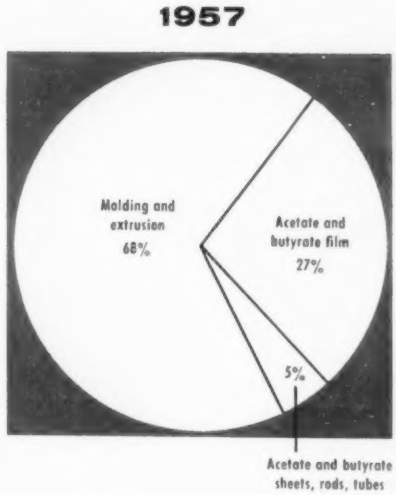
Products using plastics in large quantities[a]

Products	*1946*	*1953*	*1957*	*Est. 1958*
Air conditioners (Room units)	28,800	1,044,700	1,600,000	1,350,000
Floor type vacuum cleaners	2,289,400	2,777,700	3,190,000	3,125,000
Television sets	6,476	7,215,800	6,400,000	5,300,000
Refrigerators (Electric)	2,100,000	3,650,000	3,350,000	3,000,000
Radios	15,955,000	13,369,000	15,500,000	11,750,000
Washing machines	2,020,200	3,460,900	3,725,000	3,600,000
Automobiles	2,148,700	6,116,900	6,113,000	4,525,000
Trucks and buses	940,800	1,206,200	1,108,000	895,000
Dwelling units (Non-farm)	671,000	1,200,000	1,042,000	1,100,000

[a] Factory sales in units

Consumption of cellulose esters





Cellulose plastics sales, 1954-1958[a, b]

Classification	1954 lb.	1955 lb.	1956 lb.	1957 lb.	1958 lb.
Cellulose acetate and cellulose acetate butyrate sheets:					
under 3 mils	17,500,000	19,000,000	19,400,000	18,000,000	16,500,000
3 mils and over	12,400,000	15,000,000	16,700,000	18,000,000	18,500,000
All other sheets, rods, tubes	5,300,000	7,000,000	7,000,000	7,200,000	8,200,000
Molding and extrusion materials	75,500,000	90,000,000	92,800,000	93,000,000	88,000,000
TOTAL	110,700,000	131,000,000	135,900,000	136,200,000	131,200,000
Nitrocellulose: sheets, rods, tubes	4,900,000	5,100,000	5,300,000	4,100,000	4,000,000

[a] Source: U. S. Tariff Commission, except 1958, which is estimated.
[b] Includes plasticizers, fillers, and extenders.

small decline in total volume consumed in 1958. There were, however, some increases in film and sheet stock. Most of this increase can be credited to the vacuum forming field—ostensibly for blister packaging—as well as to eye glass frames.

The market for "under 3 mils" was down. This field has been relatively stable for five years with little movement in either direction, although there was some indication in 1958 that polyester and polystyrene film have moved into the market to some extent. If recording tape picked up more than expected in the last three months the figure of 16.5 million lb. in the Table above may be a bit low. The chief outlets for this very thin film are magnetic, electrical, and pressure-sensitive tape; cardboard window boxes; window envelopes; and wrap-

COST TABLE: Papers – Films – Foils[a]

MATERIAL[b]	Cost per lb.	Yield, sq. in./lb.	Cost per 1000 sq. in.
Glassine			
Bleachea, 25 lb.[c]	$0.24	17,280	$0.014
Lacquer coated, moistureproof, heat sealing, 28 lb.[c]	0.45	15,428	0.029
Laminated, amber, 47 lb.[c]	0.30	9,191	0.033
Laminated, bleached, 47 lb.[c]	0.31	9,191	0.033
Waxed paper			
Bread-wrapper grade, 39 lb.	0.28	11,080	0.025
Liner grade, moistureproof, amber, 31 lb.	0.22	13,935	0.016
Cellophane			
Moistureproof, heat sealing (300 MS)	0.62	19,500	0.032
(300 MS 51 or MS-1 type)	0.62	21,000	0.030
Moistureproof, water resistant (300 MSA or MSB)	0.69	19,500	0.035
Polymer-coated (300 K, OX or R)	0.79	19,500	0.041
Cellulose acetate			
Cast (1 mil)	0.93	22,000	0.042
Extruded (1 mil)	0.74	22,000	0.034
Polyester film (1 mil)	2.25	20,000	0.112
(½ mil)	2.75	40,000	0.069
Heat sealing (2 mil)	2.60	13,400	0.194
Polymer-coated (½-mil base)	2.50	27,500	0.091
Polyethylene			
Conventional (1.5 mil)	0.53	20,000	0.027
High density (1 mil)	0.74	29,000	0.026
Polyethylene-cellophane (1 mil poly-300 MS)	1.07	11,800	0.091
Pliofilm (80 FM-1)	1.10	31,000	0.035
Saran (1 mil)	1.08	16,300	0.066
Vinyl Cast (1mil)	0.87	21,600	0.040
Extruded (1 mil)	0.78	21,500	0.036
Foil-acetate (1 mil Al. foil-1 mil acetate)	1.47	6,490	0.230
Foil label stock (0.00035 Al. foil-30 lb. paper)	0.44	9,240	0.048
Aluminum foil (unmounted)			
Thickness, inches			
0.00035	0.83	29,300	0.028
0.0005	0.79	20,500	0.038
0.0007	0.75	14,600	0.051
0.001	0.70	10,250	0.068

[a] This comparison of approximate costs is intended only as a guide. The figures given were obtained from 1958 price lists and are based on "volume" orders.
[b] Typical packaging gages, standard commercial grades, unprinted, are given here. The reader must understand there are other commercial grades, thicknesses, and types.
[c] Based on a ream of 500 sheets, 24 by 36 in., or 3,000 sq. ft.
Courtesy Modern Packaging Encyclopedia Issue, 1959.

ping. Polystyrene moved into the window envelope field because of lower cost.

Most of this film is cast. What little extruded film is used in this gage finds its way primarily into envelopes and wrapping material for tomatoes. The best growth potential is probably recording tape, which is an expanding field where acetate seems to offer the most desired properties, i.e., it doesn't stretch like polyester film.

It is believed that continuous film over 3 mils would be about the same as 1957 unless the last three months of 1958 failed to live up to expectations. This thicker film has grown more than the thin type because of use in vacuum forming and automatic production of containers. The automatic blister packaging of small items such as low-wattage electric light bulbs, spools of thread, razor blades, etc., which was introduced at the 1958 Packaging Show could be a tremendous boost. However, this application becomes economical only when the product to be wrapped is produced in million-quantity lots. Both acetate and butyrate film are included in this category. Butyrate has had a good solid market on the Soundscriber recording machine belt for years and is particularly desirable in blister packaging of such heavy items as hardware because of its strength and stability. The customer pays more, but he likes the extra quality.

Sheets (as distinguished from continuous sheeting), rods, and tubes showed a good advance over 1957, with an increase in several areas, particularly in vacuum forming and eye glass frames. The public seems to like the variety of eye glass frames that can be made from different acetate laminations. Windshields for motor scooters, graphic arts materials, and sequins are good sheet outlets. Butyrate signs that withstand outdoor weathering are also listed in this classification.

Thermoformed acetate and butyrate film and sheeting is believed to account for 8 to 10 million lb. of material. At least 4 million lb. of sheet is thought to be thermoformed for such items as display bottles, toys, novelties, light diffusers, stop-light and directional signal lenses, light shades, and decorative items. About 2 million lb. more are formed into signs and displays. Some 4 million lb. of "over 3 mil" continuous film are estimated to have gone into the packaging market.

When this estimate was made late in '58 it looked as though molding materials wouldn't quite reach 90 million lb. that year. This is the first decline in four years, but the figure is no-

where near the low mark of 75 million in 1954. Ever since that time the yearly totals have been just over or under the 90 million-lb. mark, and there is some justification for believing they may stabilize at that point. The cellulosics have been handicapped ever since the war by a raw materials cost that was higher than for most other thermoplastics. The resultant high price of flake or molding material has robbed the cellulosics of many markets now in lower-cost polystyrene or polyethylene. But the cellulosics are easy to mold and have a degree of toughness which is hard to equal; and they have therefore found their own niche where nothing else is suitable. If they grow to any extent it will have to be through new applications *(To page 171)*

Methacrylate

Use of methacrylate molding materials is thought to have been down by about 10% in 1958 compared with 1957 up to November 1, but the state of automotive ordering in the last two months of the year was not known when this review was written. October automotive ordering was roughly 10% under 1957; but 1957 orders were high because auto companies anticipated greater production than was actually realized. The auto industry reportedly uses close to an average of 2 lb. per car—thus consuming between 8 and 9 million lb. in 1958. This was 2 or 3 million lb. under 1957.

There were no startling new developments for either material or applications in 1958, but there was progress along lines that have been developing over the last few years.

Among these trends was the introduction of an improved molding material that can be processed at a higher temperature. This improved thermal stability in the machine results in faster molding cycles and lower reject rates.

Implex, an impact-resistant methacrylate by Rohm & Haas, which became available on a sizable commercial scale in December 1957, made good progress in 1958. The first big application was shoe heels, where its acceptance made a dent in other thermoplastics going into that market. Other uses that developed were for some types of soft-drink vending machines, piano keys, combs, pipe bits, and extruded sheets for trays and other industrial uses where resistance to staining is important.

Growing acceptance of Du Pont's methacrylate sirup as a replacement for polyester in reinforced plastics panels and glazing materials was also reported. Several companies are now producing panels using the sirup. They base their sales appeal on its superior weathering properties, which makes it desirable for outdoor applications; and they even suggest reinforced plastics made with methacrylate sirup as a replacement for galvanized iron in such uses as awnings and partitions. The sirup is a partially polymerized mixture of methacrylate polymer and monomer, with the customer completing polymerization when he applies it to the job. When compared with cast acrylic sheet for such applications as light diffusers, a glass-reinforced methacrylate sheet is claimed to be 50% less costly; to withstand higher temperatures and show less creep than unreinforced polystyrene or acrylic sheet; and to be usable in larger panels without support.

Methacrylate lacquer for surface coatings also moved forward in 1958 when General Motors reportedly used it on 35% of its passenger cars and, according to a reliable authority, will use it on all 1959 cars.

An interesting reverse trend in methacrylates was the withdrawal by Hercules Powder Co. from its announced plans to build a facility in Missouri. Hercules gave no reason for this action other than managerial judgment. The trade guesses that lack of sufficient future markets for methacrylate and by-products produced in the manufacturing process and a competitive situation with present suppliers who have raw materials close at hand and a ready market for their by-products contributed to the Hercules withdrawal.

However, there are still several other companies who are investigating the possibility of building a methacrylate plant. A third producer may yet materialize within the next year or two. The newly announced Dow copolymer of styrene and methyl methacrylate is an interesting angle in this situation.

The two producers will give no estimates on methacrylate sales or capacity, but there are various analysts who have been studying the field for several years whose evaluations are close enough together to give a measure of authenticity to their findings. Their consensus is that from 25 to 28 million lb. of methacrylate molding and extrusion material were consumed in 1958. Among the molded items that showed an increase in 1958 was jewelry. Another strong item was brush backs with perhaps 300- to 400,-

EXPORTS RELATING to PLASTICS

(in millions of pounds)

Materials exported	1955	1956	1957	1958[a]
Benzol and benzene (million gal.)	2.5	2.7	2.7	5.4
Phthalic anhydride	18.0	6.5	22.3	12.7
Urea and melamine plastics	16.0	17.8	19.6	13.0
Cellulose ester molding and extrusion compounds	8.6	8.0	8.1	6.1
Cellulose ester plastics except molding, extrusion, and scrap	11.2	10.6	11.6	6.7
Vulcanized fibre	6.5	6.8	6.3	4.1
Styrene polymer and copolymer resins	44.0	57.9	63.1	53.9
Vinyl and vinyl copolymer resins, uncompounded	35.0	33.7	30.2	14.8
Vinyl and vinyl copolymer resins, compounded	16.0	13.7	15.1	13.2
Polyethylene resin, unfinished and semi-finished, except laminating film, and sheeting	—	—	192.0	152.0
Polyethylene film and sheeting, except laminating	—	—	—	7.2

[a] First eight months.

000 lb. a year going into this item despite the heavy invasion of polystyrene. Molded lenses for lighting fixtures constitute another solid product, with one company specializing on large volume production of this item exclusively. Molded signs of comparatively small size and more economical than sheet when ordered in large quantity are also a steady consumer of molding material. Louvers and medallions for refrigerators and other appliances were of course down in 1958 because of the depressed level of appliance sales.

Extruded sheet for use in signs and some types of lighting fixtures began to show signs of growth in 1958. Light troughs, both extruded and fabricated from sheet may have consumed as much as 1¼ million lb. in 1958. Total of all extrusion material probably accounted for less than 5 million lb. of the above 28 million figure.

Cast sheet is thought to have consumed 35 to 40 million lb. of methacrylate in 1958, about the same as in 1957. Sheet used in aircraft may not have been over 3 million lb., and the future of this application is not promising. It doesn't seem to be particularly applicable to jet planes where glass laminates are being employed for windows because of a temperature problem that requires a 400 to 500°F. heat resistance, but triple-glazed methacrylate windows are used on commercial jets.

Signs and glazing are still the biggest outlets for cast sheets with a gradual increase in ceiling-type light diffusers. Boat windshields are another sizable application.

There are now several producers of cast sheet in the country and a distribution system that is getting stronger every year. Today, a customer may obtain small quantities down to one sheet at a time; there are hundreds of small cities in the U. S. with sign and fabricating shops who want to buy in small quantity.

Methacrylate monomer used in various types of coatings is also increasing in volume. Consumption of the lacquer type mentioned above for autos at 4 lb. per car may have been as high as 4 million lb. in 1958. A small portion is also used in acrylic paints along with acrylate monomer. A guess for the amount of methacrylate used in all types of coatings for 1958 is around 6 million pounds.

Still another use for methacrylate monomer is as a lube-oil additive to improve viscosity. Guesses range from 12 to 20 million lb., although it is probable that a good portion of this is lauryl rather than methyl-methacrylate.

An export figure of 12 million lb. is also included in the 1958 total, but in this instance both acrylate and methacrylate are included in the total.—END

Nylon

Nylon celebrated its 20th birthday in 1958. The first item to be produced was bristles for tooth brushes, quickly followed by nylon stockings. Molded and extruded items did not become commercially available until the late 1940's. Du Pont, the first producer, has just recently completed a 60% expansion of its nylon

plastics plant which indicates that company's confidence in the future of nylon.

Other producers now in the business are Allied, Spencer Chemical, and Foster-Grant. Their material is made from caprolactam and is generally known as nylon-6; Du Pont's material is nylon-6/6. Nylon-6 originated in Europe and became competitive with nylon-6/6 after World War II. It is now being suggested particularly for large moldings and extrusions. Volume use in the U. S. is still quite small compared with nylon-6/6. Du Pont has always had a formulation made from caprolactam but never promoted it to any extent. An interesting sidelight on this situation is that Du Pont recently announced plans for construction of a caprolactam plant to produce the material by a lower-cost method.

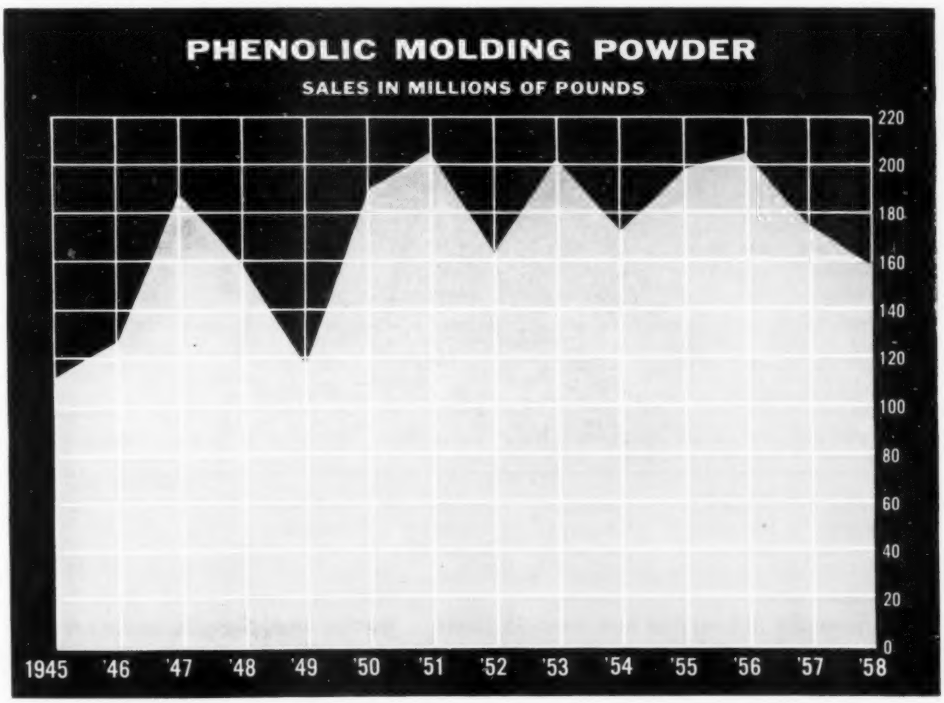
Molders in the industry are much concerned over the possible effect on nylon of Du Pont's new acetal resin, Delrin, which will enter the field in commercial quantity in 1959 or '60. Delrin will be introduced at 95¢/lb., but is expected to decline in price as soon as it becomes fairly well established. Nylon is $1.18/lb. in the U. S. and around $1.00 in Europe.

Nylon, Delrin, polypropylene, and linear polyethylene are expected to wage a battle for many of the same applications during the next five years and "price" is likely to be the most important property in determining which one will hold the market.

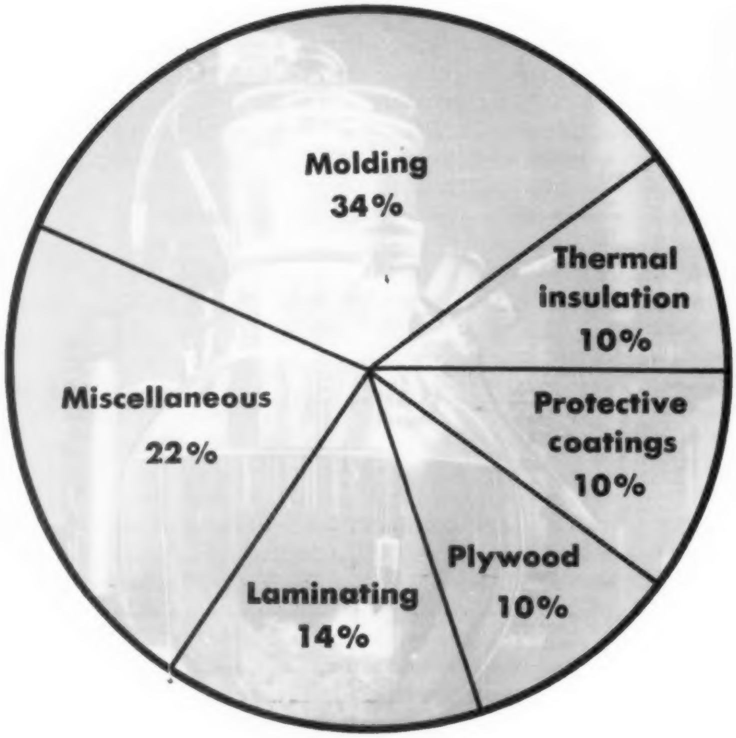
However Du Pont insists that Delrin will be supplemental to nylon, rather than in direct competition. It is said to be as different from nylon as nylon is from Dacron. Delrin is unaffected by water, will be used where more stiffness and dimensional stability are needed. *(To page 172)*

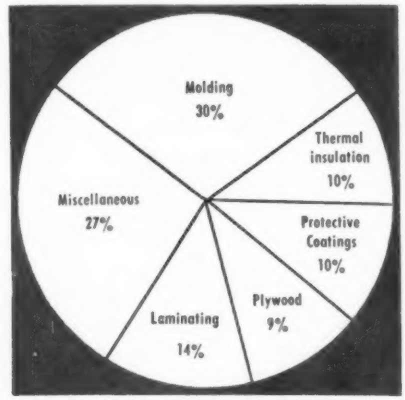
Phenolics

Whether phenolics were showing the effects of old age or merely following along with the general business recession in 1958 is not quite clear. But they did go down. However, the decline in total phenolics business was only 10 to 12%, which was certainly not unusual in 1958 for an industry that depends largely upon durable goods products for its customers. Here and there along the line the drops were sharper and the first half of the year was a real gloomy one for the producer as well as the processor;



Phenolic consumption by end uses





Phenolic resin consumption[a, b]

Use	1954 lb.	1955 lb.	1956 lb.	1957 lb.	1958 lb.
Molding materials	172,000,000	200,000,000	204,000,000	184,000,000	161,000,000
Laminating resins[c]	64,000,000	82,000,000	70,000,000	74,000,000	64,000,000
Abrasives	11,000,000	16,000,000	16,500,000	17,000,000	13,000,000
Friction materials, brake linings, etc.	15,000,000	22,000,000	16,000,000	16,000,000	15,000,000
Plywood	28,000,000	36,000,000	42,000,000	47,000,000	48,500,000
Insulation for rock wool, fibrous glass	37,000,000	52,000,000	55,000,000	53,000,000	49,000,000
All other bonding resins[d]	13,000,000	27,000,000	32,000,000	51,000,000	40,000,000
Protective coatings[e] modified and unmodified	22,000,000	25,000,000	26,000,000	50,000,000	48,000,000
Miscellaneous	27,000,000	29,000,000	37,000,000	40,000,000	30,000,000
TOTAL	389,000,000	489,000,000	498,500,000	532,000,000	468,500,000

Note: Production figure is used in years 1957 and 1958 since a large part of phenolic production is used captively and production figure is thought to be more truly expressive of actual consumption than a sales figure, and difference between production and sales is relatively minor. Comparison with previous years is not seriously affected since trends remain about the same.
[a] Source: U. S. Tariff Commission, except 1958, which is estimated.
[b] All on solid resin basis, except molding materials, which includes about one-half filler.
[c] Years 1957 and 1958 are adjusted to include resin not reported to Tariff Commission.
[d] There is a great difference of opinion concerning this figure. Analysts believe that it should be much larger and that much material reported as "miscellaneous" rightfully belongs in this bonding resin category.
[e] Years 1957 and 1958 include modified phenolic resins which are reported under "rosin modifications" in another section of Tariff Commissions' monthly report in recent years.

but, fortunately, business picked up in the last half of the year.

The phenolic industry is now over 35 years old—there are men in the industry who have spent their business lifetime almost exclusively in this field. While 35 is not old for many materials such as wood, iron, copper, rubber, leather, etc., phenolic is the second oldest commercial plastic there is. And nitrate, the oldest, was never a large-volume item when measured

by modern standards. Whether a 35-year-old synthetic material like phenolic can continue to grow in usage like wood and iron is doubtful, since the latter cover a much wider field of application. Phenolics have been around long enough so that anyone who has a possible application in mind would have experimented to find out if the material is useful for his purpose. As a result, major new markets were few and far between.

There have been applications of great promise that thrived furiously and then died out. Many others that had great promise have not yet and may never materialize in big volume. Television cabinets, shell molding, foam, extruded pipe, Microballoons, low-pressure laminates using phenolic resin are a few examples. Competition from other plastics in applications where phenolic might have been used had the other materials been unavailable has held down the growth of phenolics and this trend shows signs of growing stronger. And worst of all, the profit picture in most phases of phenolics is not encouraging.

But despite all these obstacles, most analysts expect phenolics to grow at about the rate of population growth, and producers are always hopeful that some new application will suddenly burst through to create new or improved markets—as thermal insulation, washing machine agitators, steam iron handles, or television cabinets have done in the past. Incidentally, the extreme ups and downs shown in the graph for molding powder, below, were generally caused by the sudden emergence of some such new application, or a spurt resulting from national emergencies.

The largest use of phenolic resins shown in the Table on p. 92 is molding material; but less than half of the poundage is solid resin—the balance is filler. All other figures in this table are based on a solid resin content.

The last two columns in the table are based on production instead of sales. The reason is that many phenolic users make part of their own resin and it is believed that production is a better measure of consumption than sales.

Molding material consumption started picking up in August. In the first six months of 1958 it was 20% under 1957. But in September it was back up to 15 million pounds. The industry seems fairly content when that amount of material is being processed. When it gets up around 18 million, executives carry a grin reminiscent of boom times. But with one exception, there have only been two 18 million-lb. months since 1953, although the industry was running close to that amount in every month during the first half of 1956. The two 18 million-lb. months were October and November

PHENOLIC MOLDING POWDER END USE VOLUME

End use	1956 lb.	1957 lb.	1958 lb.	1959 lb.	1963 lb.
Electrical controls (panel boards, switch gear, etc.)	38,000,000	34,000,000	30,000,000	33,000,000	35,000,000
Wiring devices	34,000,000	34,000,000	40,000,000	39,000,000	30,000,000
Closures	17,000,000	13,500,000	12,000,000	13,000,000	13,000,000
Utensil and appliance handles, knobs, bases and housings	29,000,000	26,000,000	20,000,000	24,000,000	32,000,000
Telephones	6,000,000	5,000,000	5,000,000	5,300,000	1,500,000
Washing machines	11,000,000	11,200,000	9,500,000	10,000,000	7,000,000
Automotive	11,000,000	12,000,000	10,000,000	12,000,000	15,000,000
Vacuum tubes	6,000,000	6,000,000	5,000,000	5,500,000	5,200,000
Radio and TV condensers and resistors	2,000,000	2,000,000	2,000,000	2,200,000	2,500,000
Camera parts	7,000,000	8,000,000	7,500,000	7,000,000	5,000,000
Miscellaneous*	43,000,000	27,000,000	19,000,000	29,100,000	49,800,000
TOTAL	204,000,000	184,000,000	160,000,000	180,000,000	196,000,000

* Miscellaneous includes such things as caster wheels; textile machinery; office equipment; toilet seats; vaporizers; buttons; and exports.
NOTE: Figures are all rough estimates and are given to indicate applications which are expected to grow or decline.

1955. In the first half of 1953 the industry was operating near 20 million lb. every month.

The biggest month of all for sales of resin to consumers (the exception noted above) was 25 million lb. in October 1957. But that figure is very misleading. Producers had given notice that the price was going up on November 1, and everybody filled his bins. Sales dropped to 9 million lb. in that November, the lowest month on record for many years. They didn't get back to 13 million until January 1958, and then dropped back until August of that year.

Price of general-purpose molding powder has increased from 13½¢/lb., where it was frozen during the war years, to 21.2¢ in 1957, except for a slight fluctuation in 1954. It dropped to 19.2¢ in the early summer of 1958. This drop was confined to a few of the most widely used formulations in the hope that molders would use more of them than some of the higher priced specialty materials and thus permit producers to concentrate on making the more widely used varieties. The idea was to help cut costs on the part of both producer and molder and to help eliminate price irregularities which had existed previously.

An important event during 1958 was the withdrawal of Monsanto from the phenolic molding powder business. Monsanto was generally considered to be the third largest producer of phenolic molding powder. Its departure from the business, however, still leaves an industry capacity which is far in excess of the current rate of consumption. *(To page 174)*

Urea and melamine

The sales curve for urea and melamine resins during 1958 generally paralleled the ups and downs of the over-all economy, reaching its lowest point around May. Since then it has been climbing fairly steeply and gives every indication of a strong comeback in the last quarter of 1958. The notable exception to this down-and-up pattern is the steady growth of dinnerware, which consumes about 90% of all melamine molding resins, or some 40 to 45 million lb. of alpha-cellulose-filled melamine.

COST TABLE: Plastics for molded containers

Type of material		Base price[1] per lb. $	Specific gravity, molded	Cost per cu. in., cents	Color range	Molding method[5]
Acrylics	Clear	0.55	1.18	2.36		I
	Colors	0.59	1.18	2.51	Unlimited	
Cellulose acetate	Clear	0.52	1.3	2.44		I
Translucent	Colors	0.48	1.3	2.25	Unlimited	
Opaque	Colors	0.40	1.3	1.88	Good	
Butyrate	Clear	0.62	1.28	2.87		I
	Colors	0.62	1.28	2.87	Good	
Ethyl cellulose	Colors	0.72	1.15	2.99	Good[4]	I
Melamine[2]	Colors	0.47	1.50	2.55	Good[4]	C
Phenolics[2]	Brn. or blk.	0.195	1.36	0.95	Limited	C
Polyethylene	Natural	0.35[3]	0.92	1.16		I
	Colors	0.44[3]	0.92	1.46	Limited	
Polypropylene	Natural	0.49	0.90	1.60		
	Colors	0.58	0.90	1.90	Good	I
Polystyrene[2]	Clear	0.24	1.05	0.92		I
	Colors	0.27	1.06	1.04	Unlimited	
Modified styrene	Natural	0.32	1.07	1.23		I
	Colors	0.345	1.07	1.33	Good[4]	
Ureas	Colors	0.34	1.50	1.84	Good[4]	C

[1] The prices given here are those prevailing at the time this table was prepared. Current prices should be obtained for purposes of actual comparison.
[2] General-purpose grades.
[3] Polyethylene resins now available range in density from 0.913 to 0.960, and prices for natural range from 35 to 43¢ a lb.; for colors, from 44 to 52¢ a lb. Cost per cu. in. ranges from 1.16 to 1.52¢, natural; and in colors from 1.46 to 1.80¢.
[4] In solid colors. [5] I—Injection molded. C—Compression molded.
Courtesy *Modern Packaging Encyclopedia* Issue, 1959

UREA AND MELAMINE RESIN SALES[a]

Uses	1955 lb.	1956 lb.	1957 lb.	1958 lb.
Textile treating and textile coating resins	41,000,000	40,000,000	38,000,000	36,000,000
Paper treating and paper coating	23,000,000	25,500,000	23,000,000	23,000,000
Bonding and adhesive resins for:				
Plywood	94,000,000	102,500,000	94,400,000	92,000,000
All other bonding and adhesive uses[b]	28,000,000	24,000,000	32,000,000	35,500,000
Protective coating resins, straight and modified	29,000,000	29,000,000	27,800,000	22,000,000
Resins for all other uses, including molding[c]	86,000,000	90,000,000	105,000,000	95,000,000
TOTAL	301,000,000	311,000,000	320,200,000	303,500,000

[a]Source: U. S. Tariff Commission, except last 4 months of 1958, which are estimated.
[b]This figure includes resin used for chipboard, melamine laminates, and commercial adhesives.
[c]Includes filler for molding material. The total for 1958 is thought to include 46-50 million lb. of melamine molding material, 40-45 million lb. of urea, and 5 million lb. of miscellaneous.

There has been a strong swing towards decorated melamine dinnerware, and it is thought that the volume of such dinnerware sold in 1958 is twice that of 1957. Main growth has been in the consumer market, although schools, hospitals, and camps are also volume users of these virtually unbreakable dishes. So far, restaurants have been slow to accept melamine, but the more translucent materials and improved methods of decorating have attracted such institutions as the Army, Naval, and Air Force academies.

Within the past year companies with marketing experience in such fields as silverware, glass, and china have entered the melamine dinnerware industry and it is anticipated that they will make a significant contribution towards its growth.

Closures still provide a growing market for urea-formaldehyde, amounting to about 17 or 18 million lb. of resin in 1958. Containers for drugs and cosmetics are particularly good prospects because urea has good resistance to essential oils. Fast-curing ureas, developed specifically for automatic molding of small items, also contribute towards maintaining the strong position of the material in the closure market, which once was expected to be taken over by thermoplastics.

Wiring devices, largely tied to the fortunes of the building industry, do not show a very dramatic growth, but both urea and melamine sales have increased steadily in this field. About 90% of all new houses now use ivory urea instead of phenolics for surface or exposed wiring devices. A wide range of colors and good electrical properties of urea and melamine are thought to insure their continued steady growth in this field. Wood flour-filled melamine, costing about 42 to 50¢/lb., is used for run-of-the-mill building applications, such as switches, circuit breakers, etc. In the aircraft industry, and in applications where higher performances are required, mineral-filled melamine, costing around 65¢/lb. is generally employed; and glass-filled melamine which costs about 85¢/lb. is used where high strength and particularly outstanding electrical properties are essential.

The button business, which was the largest single end use for urea in the '30s, is now one of its smallest markets. A large share of the business has gone to polyesters. However, the issuance of military specifications limiting the choice of materials to melamine because it can be autoclaved, has resulted in renewed sales increases of melamine for this application.

Melamine also continues to dominate the electric shaver housing market, where its superior resistance to heat, staining from perspiration, soaps, and lotions commonly used in the bathroom are a dominant consideration. Washing machine agitators are con- (*To page 178*)

First Bachner Award

Four manufacturers are honored for the application of sound engineering judgment and imagination in adapting plastics to the design of new products

TROPHY presented to Bissell Carpet Sweeper Co. by Bachner Award judges for the use of plastics in the design of the rug cleaner illustrated on the opposite page.

Engineered around 14 plastic parts and involving eight different plastics materials, a home carpet cleaner of unique design was the winning entry in the first Bachner Award Competition. With the cleaner, named Shampoo Master, a detergent is applied to rugs by means of a sponge roller and scrubbed in with two rows of bristles. It combines a detergent tank, applicator, and handle in one assembly and is designed to ease the rug cleaning chore of the homemaker. The award was made during the National Plastics Exposition and Conference held in Chicago Nov. 17-21, 1958.

The considerations which led to the selection of the winner, as well as the three runners-up, were the sound engineering judgment and imagination shown by the manufacturers in adapting plastics to the design of new products or to product improvement.

The winner

In the design of the Shampoo Master, the manufacturer, Bissell Carpet Sweeper Co., Grand Rapids, Mich., chose plastics over metal because: 1) plastics make the product lighter and thus easier to handle; 2) they reduce assembly and finishing costs; 3) they are less likely to scratch or mar furniture; and 4) they are unaffected by the rug-cleaning detergent.

The housing of the roller and brushes is molded of Dow Ethocel-80 ethyl-cellulose. Reasons for the choice were the high impact and stress resistance of the material and its moldability to sharp contours.

Polystyrene (Dow 475) was chosen for the distributing channel inside the housing; its low material cost and easy cementability were prime considerations. The same material was also selected for the tank and tank cover. In the case of the tank, a translucent formulation was used so that the height of the cleaning fluid can be observed. The roller shaft is extruded styrene tubing and runs in molded nylon bearings. With the exception of the styrene roller shaft, supplied by K-S-H Plastics Inc., High Ridge, Mo., and the nylon bearings, produced by AGP Corp., Peru, Ind., all the rigid parts are from Double D Plastics Co., Greenville, Mich., and Richardson Co., Melrose Park, Ill.

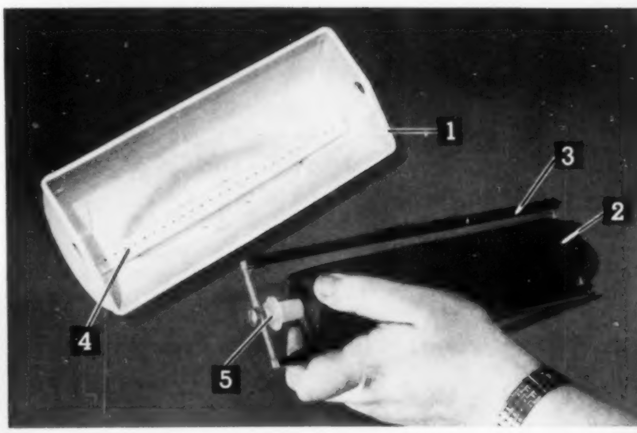
The low-cost vinyl gasket of the cleaner, which seats between roller housing and tank, gives a lasting seal. It is supplied by Lee Tire & Rubber Co., Youngstown, Ohio. The tank cap is also molded of vinyl, by Double (*To page* 98)

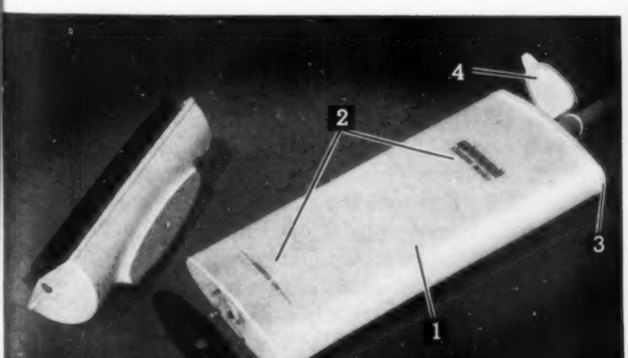
Winners

14 plastic parts in the Shampoo Master

Ethyl cellulose housing
Styrene distributing channel
Vinyl tank gasket
Styrene tank
Styrene tank cover
Vinyl cap
Epoxy-coated handle
Metallized Mylar Lurex trim
Extruded vinyl to protect trim
Styrene roll shaft
Nylon shaft bearings
Polyurethane foam roller
Saran brush bristles
Vinyl handle grip

→
HOUSING for the roller and brushes of the Shampoo Master (1 in photo at right) is molded of ethylcellulose. Roller (2) is urethane foam; bristles (3) saran; distributing channel for detergent (4) styrene; and roller shaft (5) nylon.





←
TANK (1) of rug cleaner is molded of styrene, with tradename and message (2) silk-screened on the surface. Tank cover (3) is also molded of styrene and captive cap (4) of elastomeric vinyl.

D and Richardson, because the material is soft enough to make a seal and can be integrally molded with a thin retainer ring which goes around the handle. Epoxy resin (Randolph Products Co., Carlstadt, N. J.), is used to coat the tubular metal handle to prevent corrosion.

The revolving roller, supplied by Stephenson & Lawer, and G & T Distributing Co., both of Grand Rapids, Mich., is of urethane foam, the only material found to combine adequate sudsing with good wear resistance at a reasonable price. Brush bristles are of saran, supplied by Superior Brush Co., Cleveland, Ohio, and Fuller Brush Co., Hartford, Conn.

The seam between the roller housing and the tank of the Shampoo Master is covered by a strip of Lurex (metallized Mylar), supplied by The Dobeckmun Co., Cleveland, Ohio. The Lurex is covered by a transparent protective vinyl extrusion, supplied by Backstay Welt Co., Union City, Ind. The final plastics part of the product is a vinyl handle grip, from Ohio Rubber Co., Willoughby, Ohio, and Goodyear Tire & Rubber Co., St. Marys, Ohio. It is tough, resistant to perspiration, and low in cost.

While the award trophy (illustrated on p. 96) was presented to Bissell Carpet Sweeper Co., the cash prize of $1000 that goes with it was shared by two employees designated as having been most responsible for the achievement: Robert Yonkers, chief design engineer, and Richard Herring, model maker.

Three other products honored

Three entries received honorable mention in the Bachner competition: nylon roller skates, styrene foam drinking cups, and a bath scale with housing molded of acrylonitrile-butadiene-styrene polymer blend.

The roller skates, called Zippees and made by Manning Mfg. Corp., Chicago, Ill., are said to outlast steel skates by 2 to 1. The skates can be worn indoors or out, since they will not mar floors or lineoleum. Zippees are also lighter, faster, and more colorful than steel skates.

Thermokups, the foamed styrene disposable hot-beverage cup manufactured by Crown Machine & Tool Co., Fort Worth, Texas, weigh less than 3 g., reducing raw material costs to the level of those for competing paper cups. Thermokups require no handles, since the foam is an effective heat barrier; they keep drinks hot longer than paper cups and do not impart a taste to the beverage.

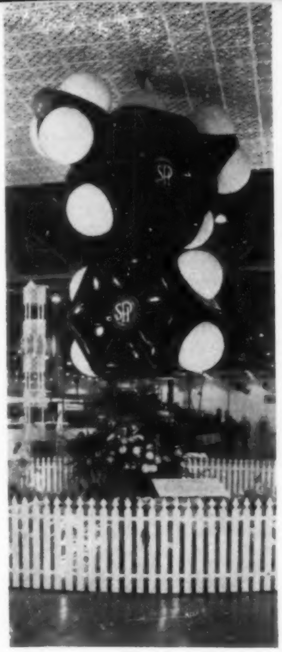
The third product selected for honorable mention is a bath scale made by The Brearley Co., Rockford, Ill., with a housing molded of Marbon Chemical Co.'s Cycolac ABS resin. The gently sloping surfaces, finely detailed areas, and unusual radii of the housing were made possible by injection molding; they could not have been produced in the die stampings common to metal bath scale housings.

The Bachner award is administered by a special committee appointed by Chicago Molded Products Corp., sponsors of the program. The 1958 committee consisted of Arnold E. Pitcher, retired general manager of Du Pont's plastics division, who served as chairman; Charles A. Breskin, chairman of the board, Breskin Publications, Inc.; Herbert S. Spencer, retired, Durez, Edward Gudeman, vice-president, Sears, Roebuck & Co.; and Arthur J. Schmitt, president, Amphenol Electronics Corp. Secretary to the committee was William T. Cruse, executive vice-president, S.P.I.

Judges for the 1957-58 competition were Arnold E. Pitcher, chairman; Dr. Ralph Gardner Owens, Dean of Engineering, Illinois Institute of Technology; Hiram McCann, Editor, Modern Plastics; Charles E. Whitney, Publisher, Whitney Publications, Inc.; Alfred Auerbach, Professor of Marketing, School of Design, Pratt Institute; and Henry M. Richardson, DeBell & Richardson, Inc., consulting engineers.

The Bachner award is open to all engaged in the manufacture of products made partially or totally of molded, extruded, or formed plastics. Fibers, filaments, flexible films, resins, and coatings are not eligible. The award is to be presented approximately every two and a half years for "excellence in the application of plastics."—End

HONORABLE MENTIONS were given to nylon roller skates (Manning Mfg. Corp.); foamed styrene hot drink cups (Crown Tool & Mfg. Co.); and bath scale (The Brearley Co.) with housing molded of ABS resin.



Report on the Show

A team of MPL editors took a close look at the 1958 National Plastics Exposition and Conference held in Chicago Nov. 17 to 21. Here is what they found

THEME CENTER at the show. The giant "Plastonium," ceiling, picket fence, and pillars were all vacuum formed of styrene sheet by W. L. Stensgaard and Assoc., Inc., Chicago, Ill., designer and producer of the entire theme center.

Probably the two most important observations to be made concerning the 8th National Plastics Exposition are 1) that our mechanical engineering at process level is rapidly catching up with our chemical engineering, and 2) that specific processes are being related to specific materials. The evidences of close cooperation between material makers and machinery builders were many.

Machinery

In the past two and a half years nearly every company exhibiting at the show has brought out something new. The common aim of most of these innovations is increased productivity—of investment as well as labor. In addition, some of them have increased the scope of plastics fabrication.

The most exciting things at the show were the two blow-molding machines shown, Reed's new Jetflo injection machine, the transfer molding of rigid PVC, and the wide acceptance of a principle which has been public knowledge for barely a year—precompressed injection molding. This new technique, which was described in detail in MPL, Sept. and Nov. 1958, was being demonstrated in at least five different machines.

Thermoplastic molding

Sixteen makers of injection machines were showing their latest, and their latest are very fast. One 6-oz. Reed Jetflo (see MPL, Dec. 1958, p. 164, for a complete description) has an in-line screw preplasticator and injection ram. One Jetflo at the show was producing a thin-walled cup from high-impact polystyrene every two seconds, while another was filling an eight-cavity pill-box mold on a 6-sec. cycle. The Impco 50-g. machine was molding styrene pint containers on a 4-sec. cycle. A new Fellows 6-ouncer was filling a six-cavity container mold with *high-density polyethylene* every 6 sec., using the new sequential impact molding technique.

Automation seems to have spread since the last exposition—most makers are now offering machines designed for completely automatic operation. Even at the other end of the scale—the tiny bench models—there is evidence of increasing complexity, more instrumentation, more built-in power. For example, the Newbury Eldorado is now available in a semi-automatic model. We hope these small machines will not get so fancy that small labs and short-run molders can't afford them.

In the Union Carbide Plastics booth, a Stokes transfer molding machine was being used to mold clear, rigid PVC. The fine-powder feed was heated to the molding temperature *outside* the press in a 27-mc. electronic preheater. Over-all cycle was about 1.1 minutes. Advantages claimed over injection molding for this material are 1) molder is freed of heat-sensitivity worries, 2) he can mold more complex shapes, and 3) he can get better weld strength and appearance. PVC flanges weighing up to 10 lb. have been molded by this method. Transfer molding should be of interest for other preheatable thermoplastics, too.

Speaking of preheating, W. T. La Rose says his company has successfully adapted the electronic process to continuous preheating of extrusion and injection molding feeds. Outputs of PVC wire-coaters have been boosted by 50 to 300% by preheating the dry-blend feeds! At the 80-mc. frequency of this equipment, even clear polyethylene and polystyrene can be economically preheated. Reason for excitement: theoretically, the output of an extruder served by a big-enough preheater would be limited only by the pumping capacity of its metering section, instead of by the torque-transmitting capacity of the screw, as in most plasticating extruders. Questions to be answered: How does the combination of a small extruder and preheater stack up against a well designed larger extruder costwise? Operationwise? For injection molding, the preheater serves the main function of a preplasticator, but not all its other functions. But since it is competing against a relatively inefficient heating system, it should still be valuable.

Thermoset molding

In this field, also, the most important trends are speed and automation. F. J. Stokes' engineers have taken a new tack and built *infra-red* preheating into

their 75-ton compression press. Their simple device, which agitates the powder under the glow of radiant heaters, costs about one-tenth as much as an electronic preheater. Though it is not as fast or efficient, it can cut 15 to 20% off the curing cycle. The Baker Bros. 150-ton automatic compression press now has an optional transfer molding feature. New presses by Dake Corp. have taken another direction—bigger bed areas and higher tonnages. Automold was showing its new Thredmolder, an air-powered 50-ton press especially designed for molding threaded parts. Hull Corp., in addition to its latest presses, had on deck a self-contained vacuum potting system for handling thermosetting casting resins. Thermoset molders will also welcome an ingenious and inexpensive powder feeder offered by Whitlock Associates. This is simply a vertical screw conveyor capable of delivering up to 400 lb./hr. and fitted with a torque-cut-off clutch and timer to regulate feeding.

Extrusion

All the extruder makers have become more conscious of and interested in control of the process and in improved extrudate quality. This is one face of the productivity coin; the other, of course, is output. What might be termed the "L/D race" reached a new extreme at the Egan booth, where a 2.5-in. vented screw 36 diameters long was operating. This special screw is essentially a 16-to-1 screw attached to a 20-to-1 first stage. To avoid the common problem of having the melt climb out of the vent, a tunnel is cut through the core of the screw in the region of the vent. The first half of the screw ends in a short reverse-flighted section that keeps the melt from reaching the vent and forces it to pass through the tunnel into an early flight of the second half, past the vent. A vented machine so equipped should be able to handle a wider variety of materials than those of simpler construction.

The big news at NRM was the successful production of half-inch-thick sheet from high-impact polystyrene. This sheet is being used in Britain for formed refrigerator boxes. NRM's new induction-heated extruder was on show, as was the induction-heated EPE extruder, newly acquired by Farrel-Birmingham.

John Royle & Sons are trying a new trick in extruder cooling: their medium is air carrying a water spray. This may give faster cooling than one gets with dry air, but without the nasty shock that goes with liquid water.

A new Reifenhäuser 2.5-in. extruder (shown by H. H. Heinrich Co.) has a "floating screw" that can be hydraulically shifted lengthwise to control the slit aperture in the conical valve built into its forward end. Shifting can be done while the machine is running by turning a valve and watching a clever position indicator. This booth also showed a versatile caterpillar-type pipe puller capable of drawing off pipe of any diameter from 0.5 in. to 10 inches.

Modern Plastic Machinery Corp.'s new Century line, described in MPL, Dec. 1958, p. 160, was on display, as was the new Davis-Standard Thermatic series (see MPL, July 1958, p. 144).

The trim Prodex extruders were embellished at this show with some beautiful dies and valves. Especially ingenious is the new flow-control valve, free of dead spots in all control positions yet adjustable over a wide range. Three valves are used in a dual pipe die to provide easy and independent regulation of melt working and extrusion rates through both heads of the die.

Something new in extrusion take-offs for shapes is the Plastimaster, by H & T Machine Works. This is essentially a bank of four powered rubber rolls that can be driven at speeds from 15 to 235 ft./min., that are adjustable in height and bite, and that can be quickly swapped for other sets specially shaped to handle any particular extrudate.

Blow molding

For a long time blow molding has been a private art in this country. A few leading companies have held important patents and have hugged to their breasts even more important secret know-how. Smaller operators were not advertising their work, for various reasons.

Now some of the basic patents have expired and others are being licensed, and soon a number of blow-molding machines will be offered for sale on a commercial basis. Two of these were shown in Chicago and interest in them was keen. Both the Blow-O-Matic and the Kautex machines are being sold under license, and some royalties will be involved in their use. They are capable of blowing a variety of hollow shapes—bottles, toys, "cans," etc., and are used in conjunction with an extruder. The extruder forms a tube that is clamped in a two-piece mold, inflated, chilled, ejected, and trimmed by hand. At the show, the Blow-O-Matic was turning out a small rectangular "can," while the Kautex machine was making bellows-shaped push-bottles in a 2-cavity mold at the rate of two every 4.6 seconds. These machines cost on the order of $10,000 without the extruder and are used with extruders in the 2- to 3-in.-diameter range, depending on the product to be blown. By the time of the next show, there should be a good many blow molders in the U. S. and many interesting new blow-molded products. Any thermoplastic can be blow molded, though polyethylene has accounted for most of the business to date.

Sheet thermoforming

Since the last show there have been two important developments in sheet thermoforming: 1) the air-blow-assist technique, first introduced by Hydro-Chemie and now offered, with variations, by all major makers; 2) machines that form the sheet with air at higher than atmospheric pressures. In this field, too, automation has advanced and the interest of sheet formers in gaining closer control of the process has led machine makers to give them more and better instrumentation. Auto-Vac was showing new and improved models: 1) their Multi-Vac, a 30- by 50-incher with 24-in. drape and plug assist, also air-blow-assist; 2) the Pilot-Vac, a small machine designed for rapid pressure forming of packages from oriented films and for test work; and 3) an improved version of their Lab-Vac in which all parts of the cycle are timer controlled.

Conapac, new U. S. representative for Hydro-Chemie, was demonstrating its interesting tester of sheet formability (see MPL, Nov. 1957, p. 145). Shown also was the new Form-Vac Junior 59, a versatile 10- by 12-in. machine designed for research and test work and for small-volume production.

Atlas Vac-Machine was putting emphasis on providing complete forming "departments" in several size ranges. Each department consists of feeding, forming,

and trimming equipment needed to do certain classes of jobs, principally packaging. Its new A-14 model—forming area 14 in. square—does all this in one machine.

Trimming has always been a bit of a problem with formed items, and trimming oriented polystyrene has been particularly troubled by cracking of pieces. A new line of trimming presses by Tronomatic uses a contact-heat assist to overcome this problem.

Miscellany

New decorating equipment shown included a vacuum metallizer by NRC with a planetary-motion mounting rack, a tiny but well-built marking machine by Kingsley that can even mark untreated Teflon-coated wires, and an automatic spray painter by Conforming Matrix that washes and dries masks while the operator sprays. Devcon Corp., maker of metal-filled epoxy tooling compounds, announced that it is now offering compounds filled with metal fibers that give better strength and much faster heat transfer than powder-filled resins (see p. 118 for an abstract of a technical report on similar materials). Sturdy new cutters and grinders were on the floor in several booths, and Rainville Co. was showing the ingenious Pallmann mill (see MPL, Nov. 1958, p. 252) that can grind any plastic material to a fine powder at room temperature.

Materials and applications

Several trends discernible at the show threaded through many of the displays:

1) Materials suppliers and machinery manufacturers are drawing closer together in a mutual effort to assure better plastics products at lower cost. For example, a Kautex blow molding machine was turning out polyethylene salt shakers at Spencer's booth; a Package Machinery Co. automatic wrapping unit was handling polyethylene film at the Eastman booth; a Stokes machine was transfer molding vinyl at the Union Carbide Plastics booth; and the promotional activities at the Grace booth aimed at pushing valve gating for more economical injection molding. And at many of the materials suppliers' booths formulations were offered "specifically for blow molding," "specifically for injection molding," "specifically for extrusion," and so on.

2) The heat barrier is a prime target of the materials suppliers. On the consumer level, for example, an automatic dishwasher at the Celanese booth put high-density polyethylene housewares through the hot-water wringer and at the American Cyanamid booth measuring scoops molded of methylstyrene bobbed merrily in a pot of boiling water. On the industrial level, concentration is largely on missiles and the construction industry. A number of booths, particularly those displaying fluorocarbons and reinforced plastics, showed actual military and missile applications. At the Fiberite booth, a Lars rocket with a phenolic-glass exhaust nozzle was the center of attention. Several producers of diallyl phthalate molding compounds showed molded parts designed specifically for rocket and missile use. And at the U. S. Rubber booth, announcement was made of a polyester resin, Vibrin 136A, that can withstand a sustained temperature of 500° F. and a peak load of 1000° F. for short periods of time. At the Monsanto booth, the results of a burn-through test were shown, in which a high-temperature flame penetrated a steel plate faster than it burned through a sheet of new high-heat-resistant phenolic of the same thickness.

In the construction field, much of the emphasis was on raising the heat resistance of foamed plastics to meet building codes. At the Durez booth, a block of Hetrofoam 10 was on display. This is claimed to be a fire- and heat-resistant rigid urethane processable by a one-shot batch, hot process, and heat cure system.

3) It was obvious also that as lush markets develop, suppliers of different plastics materials will be working hard to insure themselves a share. Thus, furniture applications, outboard motor shrouds, and luggage—to mention only a few—showed up time and again in different versions and in different plastics at different supplier's booths.

4) Finally, a good many of the materials suppliers centered their displays around the over-all theme of "Plastics for Profits." At the Rohm & Haas booth, for example, a molded Implex modified acrylic container installed in a vending machine was stated to cost about one-third as much as the former model fabricated of stainless steel—and to do at least as good a job. And at the Hercules booth, corrosion-resistant ball valves molded of Penton chlorinated polyether were pointed out as being available for 75% the cost of stainless steel valves, 50% the cost of nickel valves, and 30% the cost of Hastelloy valves.

Polyethylene of all types

The 8th National Plastics Exposition may be remembered as the point at which high-density polyethylene passed from the experimental and "curiosity" stage into commercial applications. Perhaps more than any other material, polyethylene developments best illustrate the manner in which each succeeding plastics show is upgraded. At the 6th Exposition (1954) low-density polyethylene first began to show up in quantity in such basic shapes as tumblers, tubs, and basins. At the 7th Exposition (1956) low-density polyethylene had advanced to more complicated housewares, toys, and other consumer products and it was high-density polyethylene that began to appear in experimental quantities and in the same basic shapes. This year, low-density polyethylene jumped up another notch in quality—a fact that was probably obscured by the number of unique products that showed up in high-density polyethylene. These latter applications ranged from one-piece molded sunglass cases and flight bags to molded wheelbarrows and furniture and pressure-formed luggage.

At Semet-Solvay's booth, salesmen spoke about the potential of low-molecular-weight polyethylene for slush molding application. One product—an orange-shaped container for soft drinks—is already a commercial reality.

Blow molding potentials

At the Celanese booth, there was much talk about the interest displayed in the two blow molding machines (see preceding report on Machinery) on exhibition at the show and the implications for not only blow molded polyethylene bottles but also blow molded toys and housewares. The Celanese people pointed to two blow molded Fortiflex toys on display—a set of bowling pins and a ball and bat set—as indicative of this trend. Similarly, at the Spencer exhibit, blow

molded polyethylene products took a considerable part of the spotlight.

Blow molded containers of high-density polyethylene served notice at the show that glass bottles will soon face their biggest competition. In contrast to the well-known "squeeze bottles" blow-molded of low-density polyethylene, these containers are relatively rigid. Very light in weight, they offer significant shipping economies over glass containers and are virtually unbreakable under normal conditions.

It was also obvious that the film market will certainly account for a large volume of both high- and low-density polyethylene. Most suppliers felt that polyethylene film is finally challenging cellophane's long dominance in the field of overwraps—with particular emphasis on food packaging and on cigarette and cigar wrapping. One supplier even thinks he can eliminate the need for a tear seal tape in a cigarette wrapper by overlapping the polyethylene film and putting a slight nick in one edge. The Phillips people talked about a test marketing job now being done by a Knoxville bakery on a high-density polyethylene bread bag; U.S.I. showed its new cast polyethylene film; Spencer displayed a medium-density polyethylene-paper boilable food pouch; and both Monsanto and Spencer showed heavy-duty polyethylene shipping bags.

At the Phillips booth, a wide range of new types of Marlex, the 5000 series, was specifically introduced for fibers and bottles. Fibers of this new series have reportedly held loads of 20,000 p.s.i. for over 5000 hr. without failure. In view of the fact that the fibers market is one that the polypropylene people seem intent on cracking, this announcement was a particularly interesting one.

Polypropylene

Polypropylene applications were to be found at three booths—Hercules, Montecatini, and Spencer—and the potential they showed was exciting indeed. On display were a number of thermoformed and injection molded end products, films, monofilaments, staple fibers, and fabrics. Sample molded parts, floating in water, emphasized the fact that this new polyolefin resin is the lightest now commercially available. Chicago Molded Products Corp., which during the show announced the availability of extruded polypropylene sheet stock in gages ranging from 0.010 to ¼ in., and widths up to 40 in., also exhibited various experimental parts injection molded from the new resin, as well as tote boxes vacuum formed from sheet.

Reinforced plastics

Reinforced plastics materials probably ranked second to polyethylene in dominating the show. Applications shown were larger, more intricate, and more soundly engineered than ever before. Developments seemed to be taking place on many levels: quick curing resins for use in hand layup; improved resins for use in spray gun equipment; resins with greatly increased heat resistance; new techniques for pre-mix and matched metal molding; and improved low-cost reinforcements.

Some of the unusual applications, in addition to the many tote boxes, housings, and industrial components which appeared at the show, included a molded meat-curing bin weighing over 100 lb.; an experimental jeep wheel; life-size mannequins; an extremely large housing for an IBM time clock; an even larger section for a bowling alley assembly; and a series of laundry tubs. Glass and asbestos dominated as the reinforcing materials, but sisal was being shown in an air-conditioner blower housing.

Missiles and aircraft parts, of course, represent a vast application potential for reinforced plastics. Many of the parts of this nature on display turned out to be combination products in which reinforced plastics are used with wood, metals, foams, or honeycombs.

The "new" plastics

Four of the industry's newest plastics—Lexan polycarbonate resins, Delrin acetal resins, Penton chlorinated polyether, and Implex modified acrylic—made a healthy showing.

At the General Electric booth, a number of current applications for Lexan were displayed, including coil forms, camera parts, gears, and other industrial components (see MPL, Dec. 1958, p. 96). The Du Pont booth offered a range of possible applications for Delrin including such experimental parts as showerheads, gears, bushings, wheels, bearings, pipe, and handles. At the Hercules booth, Penton chlorinated polyether parts, mostly for industrial applications where a high degree of corrosion resistance is necessary, were on display.

Three large and unusual Implex applications shared center stage at the Rohm & Haas booth. One was a large colorful display molded of Implex to take advantage of the material's toughness. Molding is used for this application primarily to achieve the three-dimensional effects possible with second-surface decoration. The second was a piece of luggage with two halves formed of extruded Implex sheet, and the third was an injection molded sign letter which is expected to compete with the large letters now being pressure formed of conventional acrylic sheet.

Rohm & Haas also feel confident that Implex will give strong competition to zinc and lead die castings in the automotive and other industries.

Also introduced at the show was type 811 Plexiglas V, a new acrylic molding material with exceptional stability at high injection cylinder temperatures.

Vinyl

The big story of vinyls at the show centered around the unplasticized grades, with Goodrich showing numerous profiles for building applications (window sashes and frames, storm doors and windows, piping, etc.) and Union Carbide Plastics demonstrating a method of transfer molding the material. And right in tune with the jet age was a vinyl plastisol-coated glass fabric designed to absorb high frequency sound in jet airliners; applications in X-ray and atomic radiation shielding are anticipated.

The continuing possibilities in the vinyl-metal laminate market were also played up, particularly at the U. S. Rubber booth where there were 15 vinyl-metal laminate parts for the 1959 Ford Thunderbird, as well as luggage, cabinets, furniture, and architectural panels based on the material.

Styrene alloys and copolymers

High-impact styrene alloys and copolymers were very much in evidence at the show and the applications on display indicated that large-volume markets are

widely anticipated. At the Dow booth, for example, wall coverings designed by Raymond Loewy and formed of either 475 or 480 sheet stimulated talk about the growing trend in construction toward textured three-dimensional surfaces. Dow also had on prominent display a 16-lb. battery jar molded of Tyril styrene-acrylonitrile.

At the Foster Grant booth, company spokesmen were enthusiastic about both their Tuf-Flex graft-polymer styrene (styrene-rubber) for refrigeration, television, food containers, housewares, toys, etc., and their new styrene-acrylonitrile for tumblers, housewares, etc. A new Tuf-Flex grade, 289, specifically intended for the booming shoe heel market, was also announced.

Both Royalite and Cycolac ABS polymer blends showed up in a number of applications, including housings, shoe heels, outdoor displays, and huge safety crash pads for automobiles.

Advances in other materials

An interesting alloy was on display at the Plastics Engineering Co. booth. It is a melamine-phenolic single-stage compound with good flow and moldability, excellent light fastness, and good heat and detergent resistance. The alloy preforms, preheats, and cures in a manner very similar to phenolics and has the color potential of the melamines.

Nylon is another one of these materials that has jumped up an important notch in quality. One case in point was the spectacular 5-ft. nylon ship propeller in the Foster Grant display. One-third the weight of a similar bronze casting and with exceptional resistance to abrasion and cavitation, the propeller is already being successfully used by Scandinavian fishing trawlers operating under hazardous winter conditions.

Between the Du Pont, Allied, and Spencer booths, there were close to 200 different nylon applications on display running from tiny rollers to big tough housings for consumer products. At the Cadillac Plastic booth, some extremely large nylon-6 rod and tube extrusions attracted attention and at the Belding Corticelli booth there was much talk about nylon-8 for coating applications. Nylon film and sheeting seem finally to be moving into prominence. Spencer, for example, showed an unusual nylon film package for motor oil; Allied had some experimental samples of nylon skin-packaging jobs; and Chicago Molded announced that it was adding nylon sheets extruded in widths up to 40 in. and in a variety of colors and thicknesses to its current line.

Most of the companies displaying epoxy resins laid emphasis on low-cost tooling. At the Union Carbide booth, an epoxy resin was announced which can be applied with a single spray gun. Boat building, roof repair, and tooling were mentioned as some of the uses for the spray gun technique. To illustrate this point, the company had on display a 100 lb., 12 ft. long boat made in 3 hr. by spraying epoxy and chopped roving.

The melamine dinnerware on display appeared to be more cleverly designed than ever before and it was obvious that the molded-in decorative technique which was such a boost to the dinnerware field is now helping to push melamine into other market areas. Urea was shown not only in the traditional handles and knobs, but also in some unusual appliance housings and housewares.

Four new alkyd molding compounds with superior retention of electrical properties after long exposure to high heat and humidity were announced by Allied.

Thermoformed sheet applications

Judging from many of the exhibits, products thermoformed from various types of thermoplastics sheet stocks are growing bigger and bigger and penetrating new application areas. A trailer bathtub formed from Royalite sheet material, on exhibit by U. S. Rubber, pointed up this trend, as did a picnic cooler liner deep-drawn of the same material. Other noteworthy examples included lawn clipping receptacles formed from Kralastic ABS sheet material. A lawn mower seat and shroud drawn from Cycolac sheet and a large double-faced internally illuminated Christmas display unit formed of Tenite butyrate sheet were also shown. Among the most interesting examples of vacuum formed impact styrene sheet material were the decorative modular grills produced by W. L. Stensgaard & Assoc., Inc. Thermoformed ½-gal. ice cream packages indicated that sheet impact styrene may have an important future in food packaging.

Foams

Plastics foams were very much in evidence, particularly the urethanes and both expanded and expandable styrene. At the Allied booth, a machine was set up for continuous foaming of urethane by a new technique in which Genetron is used as a mechanical blowing agent. By replacing part of the more expensive isocyanate (the isocyanate is still used but in reduced quantities), the new system is claimed to cut costs.

At the Koppers booth, two unusual applications for expandable styrene were a huge contoured platform used to protect electric typewriters during shipment (the platform fits inside a wooden shipping case) and a new type of extruded film. The film is low in cost, has excellent thermal insulation, and can be formed and laminated. At the Dow booth, emphasis was placed on expanded and expandable styrenes for all kinds of thermal insulation.

Report on the S.P.I. Conference

Sheet Forming Session: *Presiding: C. C. Whitacre, Midwest Plastics Products Co. Speakers: Donald Leeker, Sears, Roebuck & Co.; Franz Wagner, Raymond Loewy Assoc., Inc.; Hiram McCann, editor* MODERN PLASTICS *Magazine.*

The speakers presented an optimistic outlook for the industry as a whole—however, they also managed to inject a note of warning to those who might become too overconfident.

Mr. Leeker covered "The use of formed plastics sheets in packaging and merchandising." He pointed out that retailers are looking for packages that will enable them to take the product out of the show case and get it closer to the customer—and sheet formed blisters

and skin packaging have already proved themselves as the perfect answer.

Using the same approach of changing concepts leading to bigger markets, **Mr. Wagner** spoke on "The use of formed plastics sheet in construction and architecture." His contention was that architects are swinging away from stark simplicity and barren lines toward textured and three-dimensional surfaces—both inside and out. Formed luminous ceilings, three-dimensional wall coverings, and three-dimensional plastics forms for casting concrete blocks will fit neatly into their new plans.

Mr. McCann wound up the session with an over-all discussion of "Horizons in thermoforming." Pointing out that only 3% of plastics is going into sheet forming, he emphasized that the industry has yet to realize the full potential of the method. One factor holding it back has been the huge investments in conventional metal forming techniques. On the whole, however, several interesting market potentials are shaping up. The packaging field, for one, will take much more material for thermoforming as the trend to self-service merchandising increases and as plastics costs continue to decrease. Home appliances (outside of refrigerators) seem to be coming along nicely, particularly with improved formulations more resistant to heat and abrasion. With the new alloys and the range of densities in polyethylene and other polyolefins now available, thermoformed housewares may be expected to start to roll. Formed low-cost disposables continue to hold promise. The transportation field and the furniture field are both ripe for exploitation and the combination of formable foams or foams placed between thermoformed sheets offers interesting possibilities.

Management session. *Moderator: R. L. Davidson, Kurz-Kasch, Inc. Speakers: W. R. Evans, Stevenson, Jordan, & Harrison, Inc.; Ned H. Porte, General American Transportation Corp.; Isyln Thomas, Newark Die Co.; R. C. Jack, Ernst & Ernst; John E. Press, Federal Tool Corp.*

The urgent message of this session—voiced by all the speakers—was that plastics processors must know their costs if we are to have a healthy processing industry.

To this end, management consultant **Evans** described the recently devised "basic costing" system, in which cost elements are divided into two classes—fixed costs and costs dependent upon the volume of production. Basic costing helps to clarify cost finding and to make it easier to establish prices for various sales volumes.

Mr. Porte opened his comments on estimating by recalling that 39 molding bids on one particular small part ranged from $4 to $35 per thousand, and four experts later agreed that material cost alone was at least $3.70/1000! He elucidated some of the subtleties in costing, pointing out many items unrecognized by molders.

Mr. Thomas made an eloquent plea for shifting emphasis from price to quality, in both molding and tooling. Price cutting is born of panic, based on misinformation, results in losses. The moldmaker can serve the molder better if he is given all the information needed to make the right mold for the job.

Accountant **Jack** recommended that the plastics processing industry adopt some standards for finding costs. It might be possible, for example, to establish realistic scrap allowances for certain types of work, etc., and these findings could be collected into a cost-finding "bible." Also needed are estimating plans for plastics fabrication.

Mr. Press explained his company's cost-finding and estimating system in detail, with solid examples.

Plastics-in-Building Session: *Moderator: O. L. Pierson, Rohm & Haas Co. Speakers: George Nelson, Pres., George Nelson & Co., Inc.; George Hermach, Architectural Plastics Corp.; Ralph Johnson, National Association of Home Builders; F. J. Rarig, Rohm & Haas Co.*

Volume penetration of the $50 billion-a-year building construction industry by plastics is moving closer to reality. Expectations now are that plastics may capture as much as 20% of this total.

However, before any such share can be developed, plastics must prove their superiority in five distinct areas. As outlined by **Mr. Johnson**, plastics must: 1) save on-site labor time; 2) reduce weight; 3) combine multiple functions; 4) reduce substantially, or eliminate altogether, the necessity for skill craft labor; and 5) offer components in modules.

Several of these conditions are already being met today.

One of the stumbling blocks to wider plastics use lies in conventional architectural design. Builders who erect conventional houses are likely to use conventional materials. On the other hand, progressive architects have shown a far greater tendency toward the use of plastics. For that reason, as **Mr. Nelson** pointed out, the plastics industry should make a conscious effort to support progressive architecture. Its chances for success are greatest in that direction.

A related aspect is the growing need for mutual education between architects and plastics men so that each can become more fully familiar with the other's needs and requirements. This last point was particularly emphasized by **Mr. Hermach**, who also called for intensified efforts on the part of material suppliers to establish better distribution channels for the building trades.

Building codes still constitute one major obstacle to the full utilization of plastics in buildings. The problem of fire hazards, which is the basis of many codes, seems to be the major barrier. Here **Mr. Rarig** suggested some alternate approaches. Where the code cannot be modified, the architect can develop structures with discontinuous surfaces which would prevent the spread of fire; material makers can improve the flame resistance of materials going into this field.

Cellular Plastics Session: *Presiding: Dr. Maurice E. Bailey, National Aniline Div., Allied Chemical Corp. Speakers: Edwin Edberg, Koppers Co., Inc.; Torbin Yates, Kroehler Mfg. Co.; Dr. Albert G. H. Dietz, Massachusetts Institute of Technology; Leonard W. Johnson, Sears, Roebuck & Co.; Dr. Ernest J. Storfer, Chrysler Corp.*

Plastic foams are gradually winning a place for themselves in the building industry, the automotive industry, and in various types of consumer goods. However, development of their full potential will depend not only upon cost considerations, but largely upon new or modified formulations which can do a better job than other types of foams now available.

In **Mr. Edberg's** opinion, the flammability of various cellular materials is frequently over-emphasized. Actual use conditions are often quite different from

those to which the foams may be exposed in flammability tests.

One of the most important recent developments in the rigid foam field, particularly to the refrigeration industry, is the use of fluorocarbons, such as Freon, as a blowing agent for urethane foam. The foams so produced have nearly double the thermal insulating properties of conventional urethane foam.

According to **Mr. Yates,** Kroehler is accepting cellular plastics for furniture manufacture as fast as they can be profitably integrated into its operations.

The subject of **Dr. Dietz'** conference paper formed the basis for the article "Rigid plastics foams in building." MPL, Dec. 1958, p. 91.

One of the most successful applications of cellular plastics to date by Sears, according to **Mr. Johnson,** has been the use of both ester and ether type urethane foam in mattresses. The speaker advised his listeners not to regard urethane foam as an "escape" from latex foam, but to promote it on its own merits.

Soon to be marketed is a brassiere incorporating urethane foam padding. Properties of available materials have limited other clothing applications to the ester type urethane in 3/32-in. thickness. Mr. Johnson envisioned production of clothing by spraying foam on a form, coloring the outside surface, curing, and removing the garment for trimming and finishing.

A steady increase in automotive applications of cellular plastics—particularly urethane—was reported by **Dr. Storfer.** Among the newest applications are the use of cellular polyethylene as a low-friction bearing seal in Chrysler air conditioner installations. This material has also proved useful for heater housing and brake gaskets.

Rigid urethane foam is used extensively as heater housing insulation and a possible new use is suggested by a current Ford investigation of energy-absorbing front bumpers.

Interest in molded constructions involving plastic foams is increasing as techniques improve. A cored molded polyether foam pad 5 in. thick, now in use as part of a tractor seat, indicates possibilities in this direction.

International Forum: *Moderator—Tino Perutz, Omni Products Corp. Speakers—Francisco Masjuan, Argentina; David Radford, England; Klaus Stoeckhert, Germany; Mario Ottolenghi, Italy; James R. Turnbull, Japan; Nicholas M. Yegorov, U.S.S.R.*

Each speaker concerned himself with a different phase of the plastics industry, that phase being apparently paramount in the country he represented.

Japan's plastics industry is concentrating on efficient operation, quality, competitive pricing, and speedy delivery. The Japanese situation in plastics was covered in "Japan's place in plastics," MPL, Oct. 1958, p. 109.

The report on **Italy** was heavy on applications, with strong emphasis on polypropylene. Among others, the following products have already found acceptance in Italy: garbage containers; baby bathtubs; housings for vacuum cleaners and floor polishers; automotive parts; bottles for hot liquids; kitchen sinks and basins. Fibrous glass-polyester is also active, finding such uses as prefabricated housing units, one-piece bathtub-sink-toilet combinations, air ducts, and the like.

England's prime concern is with world trade. This applies to the plastics industry as much as to the economy as a whole. Of a total production of 338,000 tons of plastics in 1956, about 97,000 tons were exported. By 1970, production is anticipated to reach 1,340,000 tons. Export markets for molding materials and finished molded products are not too reliable. However, the industry anticipates considerable hidden exports; that is, plastics parts in larger assemblies such as cars, appliances, etc.

The report from **Argentina** was very discouraging. The plastics industry there has had to contend with a turbulent political situation, unstable labor-management relations, and restrictive economic policies. These obstacles are particularly telling in the field of machinery, where import restrictions make it practically impossible to get new, foreign-made equipment . . . and the art of plastics machinery making is not too highly developed in that country. The speaker issued a plea for American plastics engineers to come to Argentina and help build up-to-date machinery.

The **Soviet** speaker gave a brief rundown on polymer research being done today in the U.S.S.R. The same information was reported in "Soviet polymer science today," MPL, July 1958, p. 111.

New machinery developments was the subject of the **German** speaker. He reported on: a seven-roll calender which can make three films simultaneously, with resulting savings in equipment and heating . . . an adiabatic extruder with simple V-belt drive . . . new screw designs, some with conical configuration . . . extruders that can produce rigid PVC sheet from 1 to 5 mm. thick and up to 5 ft. wide, as well as 10-in.-dia. pipe. Extrusion-injection molding machines are also well developed, some with interchangeable piston and screw. One injection machine incorporates a device that prints as part of the molding cycle. Blow-molding machines and polyester-glass spray guns are also in volume production.

Plastics in the Appliance Industry: *Moderator: Dale Amos, Amos-Thompson Corp. Panel members: M. W. Burkhart, Lincoln Molded Plastics, Inc.; Corliss Cummins, The Dow Chemical Co.; Dr. A. A. Pavlic, E. I. du Pont de Nemours & Co., Inc.; J. N. Ruthenburg, Kent Plastics Corp.; Charles Dyson, Whirlpool Corp.; Fred L. Tarleton, Hotpoint Co.; Harold Bull, Norge Div., Borg-Warner Corp.: and Edward Smith, Westinghouse Electric Corp.*

The panel discussion was thorough and exhaustive, even hitting such sensitive topics as the pricing situation and the economies of captive *vs.* custom molding. The points covered were as follows:

1) To meet the specialized needs of the appliance people, more time and money must be spent for research and development work *on the molder level.* Neither side should depend on the materials supplier alone.

2) Both the appliance people and the plastics people felt very strongly the need for better dissemination of plastics information to the retail salesman—the last person to clinch the sale of any appliance.

3) The wide variety of quoted prices on plastics parts is destroying the confidence of the appliance purchasing agent in plastics. As one panel member expressed it, "We are willing to pay $1 for $1 worth of merchandise but when a competitor offers the same piece for 90¢, we have to stop and think twice about it."

4) Appliance people will never go completely captive

as long as the custom processor can bring in a quality product at the right cost and in accord with delivery schedules. (See "Custom molders at the crossroads," MPL, Dec. 1958, p. 87.) One panel member representing the appliance industry felt that freight costs were one of the most important factors in determining whether or not to go captive, particularly where large parts such as refrigerator inner door panels were involved.

5) It was suggested that some attempt be made to standardize refrigerator colors so as to eliminate the difficulties and attendant higher costs of short runs.

6) There is a strong need for a better dissemination of technical information between appliance manufacturers and plastics molders and suppliers. Each side must know the engineering and design criteria under which the other works.

International Dinner: *Toastmaster: Charles A. Breskin, Chairman of the Board, Breskin Publications, Inc. Principal speaker: H. Elmer Humphreys, Chairman of the Board, U. S. Rubber Co.*

World-wide production of plastics has more than tripled in the past 10 years and in the past 20 years increased more than 20 times, said **Mr. Humphreys.** In 1958 an estimated 9 billion lb. of plastics will be produced world-wide, compared with world-wide production of both natural and synthetic rubber of only 7 billion pounds.

He pointed out that, rather than gaining at the expense of other industry areas, plastics have come to the aid of other materials and have created new markets out of research. He expects demand to triple in the next 10 years, giving us a world consumption of 27 billion lb. or 13½ million tons by 1968.

From a standpoint of international trade and development, Mr. Humphreys stated that no nation has a monopoly on research, development, resources, production ability, or market ingenuity. Looking to the future, he emphasized the importance of developing plastics with greater heat resistance, plastics which will stand up at very low temperatures, plastics which can sell at a lower cost, and new plastics to meet new needs and build new markets.

There is room in this industry, he stated, for trading know-how internationally and licensing patents to mutual advantage. Also, there are opportunities for joint ventures in which capital is involved.

Merchandising and distribution of plastic products. *Moderator: T. S. Lawton, Monsanto Chemical Co. Speakers: W. J. Connelly, Union Carbide Plastics Co.; Ralph F. Hansen, Monsanto Chemical Co.; Richard A. Winter, Federal Tool Corp.; Jerry Hanock, Sears, Roebuck & Co.; Charlotte Montgomery,* Good Housekeeping *Magazine; Elmer Thompson, Prolon Plastics.*

Mr. Lawton set the keynote for the meeting by emphasizing "the need for a stronger marketing program in the distribution of plastic products."

Mr. Connelly covered "How plastics have served home furnishings" and showed a film prepared by the S.P.I. for educating retail store personnel on the advantages of plastics in home furnishings.

The next three speakers dealt with the "Three stages of developing proprietary plastics to successful sales."

Stage 1—**Mr. Hansen** spoke on the innovation of ideas to fulfill consumer desires, and stated that the manufacturer of plastics products must first determine the correct stimuli to play upon in encouraging his potential customer to buy his product; he must then either create a new product or redesign his old one to meet the existing need.

Stage 2—Product ideas, stated **Mr. Winter,** may originate with anyone from a floor sweeper to the president of the company. A recent employee suggestion that a polyethylene wastebasket would also make an excellent potato bin put Federal into the potato-bin business within a week—as soon as a suitable hot-stamped decoration had been prepared for the baskets.

Maximum distribution is often as important as good ideas. When Federal goes into production with a new product, Mr. Winter said, dozens of types of market outlets are contacted to insure adequate coverage. This is important because often a "hot" new item is copied by competition even before tooling costs have been amortized.

Stage 3—Typical steps in developing a new product at Sears, stated **Mr. Hanock,** include: 1) studying samples of all competitive merchandise; 2) roughing out what is needed; 3) testing and material recommendations; 4) checking with manufacturers for their recommendations; 5) sessions with designers for product styling; 6) preparation of a mockup model; and 7) setting up of tooling and production schedules.

Speaking for her women readers, **Miss Montgomery** asked the plastics industry for only two things: better and more imaginative design, and a more effective way of disseminating information to the housewife on how to use and care for plastics products.

Great opportunities still exist for the custom molder, said **Mr. Thompson,** provided that he will analyze his potential markets and relate them properly to his own organization and production facilities. A recent survey showed that only 20% of the nation's 500 top-rated business firms were making use of molded plastics in their products. Obviously, this leaves room for creative selling by the custom molder.

For maximum sales results, continued Mr. Thompson, custom molder salesmen should have a fair mechanical or technical background and should be familiar with molding materials and techniques, as well as able to visualize the translation of an idea into plastics.

At the end of this session, awards were announced for the **Fourth Annual Informative Labeling Contest.** See p. 204 for details.

"You can't sell a lady what she doesn't want." *Mrs. Frances Corey,* VP of Macy's, principal speaker at the Thursday luncheon, charged that although the plastics industry has grown tremendously in the last decade, it has not been doing a vigorous job of selling plastics to the consumer. It depends too much on others—e.g., manufacturers of consumer products, such as appliances, that embody plastics parts—to do the selling job—and they don't do it. Consumers, especially the ladies, are confused by a myriad of names that they can't even pronounce, much less understand. Needed are better materials identification and molder identification. Ground can be gained by telling the customer about the specific qualitative virtues of individual materials at the point of sale. Plastics are still thought of as substitutes for other materials by many persons, whereas they are often the best possible materials for the products involved.—END

1958 Meeting of ISO/TC 61

The 1958 meeting of Technical Committee 61 on Plastics of the International Standardization Organization was held in Washington, D. C., on November 3-8. Twelve countries were represented by 57 delegates and observers as follows: Czechoslovakia (3), France (5), Germany (9), Hungary (1), Italy (1), Netherlands (3), Poland (2), Sweden (5), Switzerland (2), United Kingdom (4), United States (17), U. S. S. R. (5). Dr. G. M. Kline was chairman of the meeting and C. L. Condit (S.P.I.), F. C. Frost (A.S.A.), and N. A. Skow (S.P.E.) provided technical assistance for the secretariat, the American Standards Association.

Opening session

The Honorable Robert E. McLaughlin, President of the District of Columbia Board of Commissioners, welcomed the delegates to Washington at a reception at the Hotel Willard. Dr. A. V. Astin, Director of the National Bureau of Standards, Admiral G. F. Hussey, Jr., Managing Director of the American Standards Association and Vice President of ISO, and Henry St. Leger, General Secretary of ISO, addressed the opening plenary session. Dr. L. H. Farinholt, Deputy Science Advisor of the Department of State, described the new science attache program to the delegates at a luncheon, which was followed by a tour of the plastics and polymer laboratories of the National Bureau of Standards. Mrs. Theodore R. McKeldin received the ladies at a luncheon function given in the Governor's Mansion, Annapolis, Maryland.

The Committee approved five new Draft ISO Recommendations and six Draft ISO Proposals. A Draft ISO Recommendation listing approximately 800 equivalent terms in the three official languages (English, French, and Russian) was revised in accordance with comments received from member countries and approved for submission to the ISO General Secretariat for promulgation as an ISO Recommendation.

The new Draft ISO Recommendations describe a method for melt flow index of polyethylene, recommended practices for compression molding test specimens of thermoplastic and thermosetting materials and injection molding test specimens of thermoplastics, and standard atmospheres for conditioning and testing plastics.

The Draft ISO Proposals provide for the determination of tensile properties, dynamic mechanical properties using a torsion pendulum, the viscosity number of polyamide resins, acetone-soluble matter of phenolic molding materials, Vicat softening point, and the tracking (arc resistance) of plastics materials under moist conditions.

Action was taken to organize a new working group with the purpose of preparing specifications for plastics materials based on current commercial practice as reflected in national standards and to consult with ISO/TC 45 on Rubber regarding standardization activity on cellular materials.

Activities of Working Groups

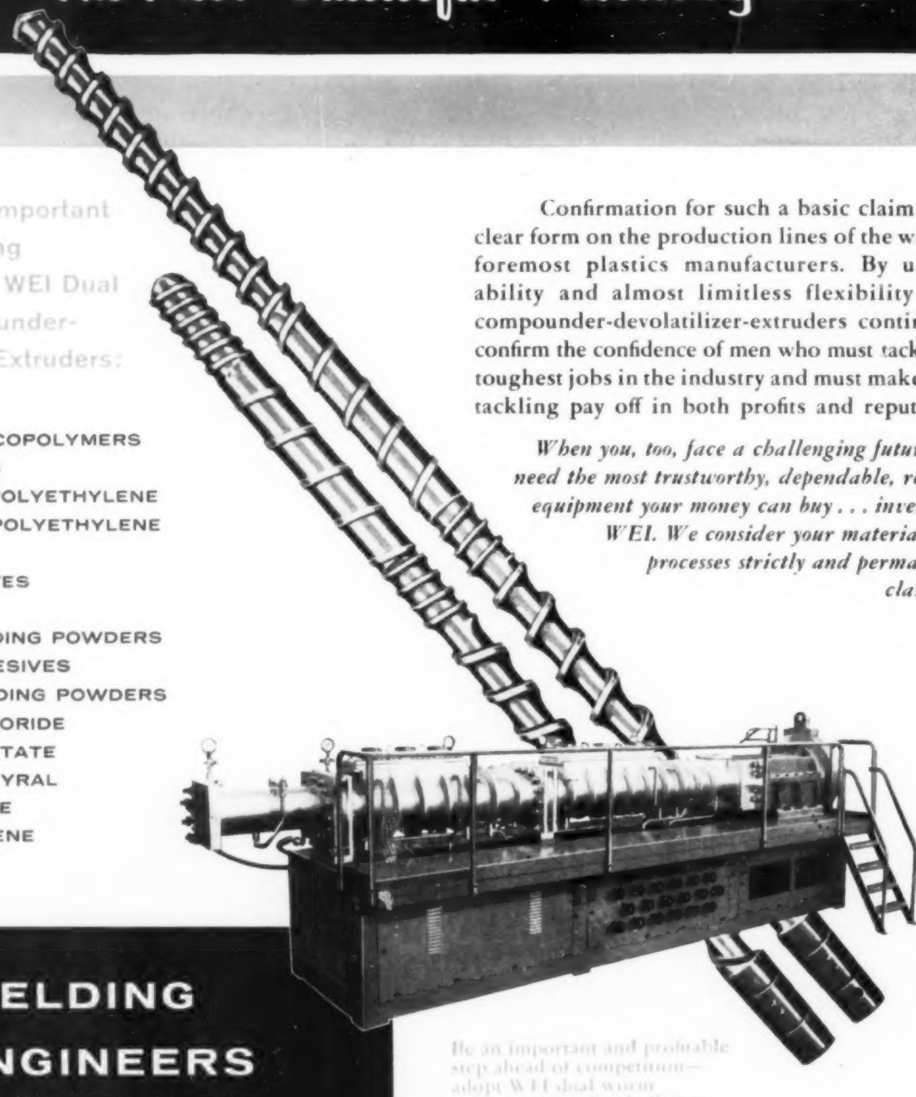
Working Group No. 1 on Nomenclature and Definitions is now compiling nationally agreed definitions of terms relating to plastics for the purpose of arriving at internationally accepted definitions.

Working Group No. 2 on Mechanical Strength Properties is preparing draft proposals for compressive, shear, and creep properties, modulus of elasticity, indentation hardness, and testing small specimens cut from molded products.

Working Group No. 3 on (*To page* 200)

OPENING session of ISO/TC 61 is addressed by the chairman of the organization's 1958 meeting held last November in Washington, D.C.

The WEI Dual Worm Design Makes The Most "Successful" Processing Sense



Some of the important materials being processed on WEI Dual Worm Compounder-Devolatilizer-Extruders:

POLYSTYRENE
POLYSTYRENE COPOLYMERS
ABS MATERIALS
LOW DENSITY POLYETHYLENE
HIGH DENSITY POLYETHYLENE
ACRYLICS
POLYCARBONATES
KEL-F
PHENOLIC MOLDING POWDERS
HOT MELT ADHESIVES
MELAMINE MOLDING POWDERS
POLYVINYL CHLORIDE
POLYVINYL ACETATE
POLYVINYL BUTYRAL
POLYPROPYLENE
POLYISOBUTYLENE

Confirmation for such a basic claim takes clear form on the production lines of the world's foremost plastics manufacturers. By unique ability and almost limitless flexibility WEI compounder-devolatilizer-extruders continue to confirm the confidence of men who must tackle the toughest jobs in the industry and must make their tackling pay off in both profits and reputation.

When you, too, face a challenging future and need the most trustworthy, dependable, reliable equipment your money can buy . . . investigate WEI. We consider your materials and processes strictly and permanently classified.

Be an important and profitable step ahead of competition— adopt WEI dual worm compounding-devolatilizing-extruding equipment . . . Write for Brochure No. 691.

WELDING ENGINEERS INC.

NORRISTOWN, PENNSYLVANIA

• West Coast Representatives—Machinery Sales Co., Los Angeles 58, California • Exclusive Sales Representatives for Europe and the British Isles—Welding Engineers Ltd. Geneva, Geneva, Switzerland

Dr. James F. Carley, Engineering Editor

Machines for thermoplastics

Industry made good showing in recession year.

Cumulative figures have been revised to account for obsolescence

Despite a serious recession that hit much of American industry where it hurts most—in the order book—makers of thermoplastics processing machinery made a good showing in 1958. Injection machine makers did a bit better than in 1957, about as well, dollarwise, as in 1956. Builders of sheet thermoforming machines probably came very close to their 1957 sales, though the figures of Table III, p. 110, indicate they did about 10% more business. Only the extruder makers showed a drop—about 6%—mostly in the 1.7 + to 3.2-in. class.

Correction of old data

We have suspected for some time that the figures reported to us were a little high. This is partly because they have to be requested in October in order to make the January issue, so companies must anticipate their deliveries for the last quarter of the year. Human nature being what it is, they tend to be a little optimistic about that last quarter. Ambiguous wording in our questionnaire has also led some companies to report sales rather than shipments. Finally, there are cancellations made after the reports have been returned to us.

To get an estimate of the size of these errors, we asked the machinery makers to recheck their delivery figures for 1956 and 1957 and report these along with their 1958 figures. We received rechecks that covered about 80% of the machines originally reported in those years. The comparison showed that the early figures on injection machines and extruders had been too high by almost exactly 10 percent. Forming machines, however, were originally reported an astonishing 45% too high! However, we have good reason to believe that the data for 1958 are subject to no more than the normal error. Even this may become smaller, now that attention has been focused on it.

We also received reports on 1956 and 1957 from a few companies who had not originally reported on those years. Their figures have been added in. The new figures in Tables I, II, and III for 1956 and 1957 should be reasonably close to the facts. The 1958 figures are as reported; they will be adjusted when rechecked next year, and rechecking will hereafter be a regular part of this survey.

The average correction factors, calculated by com- (*To page 111*)

Table I: Shipments of injection molding machines

Nominal shot capacity, oz.	NUMBER OF MACHINES SHIPPED — Domestic 1956	Domestic 1957	Domestic 1958	Export 1956	Export 1957	Export 1958
2.5 or less	333	339	365	30	8	8
2.5+ to 7	327	292	278	26	20	15
7+ to 10	65	55	68	3	7	3
10+ to 18	228	231	235	2	6	9
18+ to 29	65	38	36	5	2	2
29+ to 55	16	25	24	3	5	3
over 55	23	15	37	0	4	5
All sizes	1057	995	1043	69	52	45

Table II: Shipments of extruders

NUMBER OF MACHINES SHIPPED

Nominal screw diameter, in.	Domestic 1956	Domestic 1957	Domestic 1958	Export 1956	Export 1957	Export 1958
1.7 or less	91	99	98	19	18	17
1.7+ to 3.2	246	283	252	27	60	43
3.2+ to 4.2	250	144	141	37	46	34
4.2+ to 6.5	191	181	201	27	50	38
over 6.5	28	49	50	6	7	5
All sizes	806	756	742	116	181	137

Table III: Shipments of sheet thermoforming machines

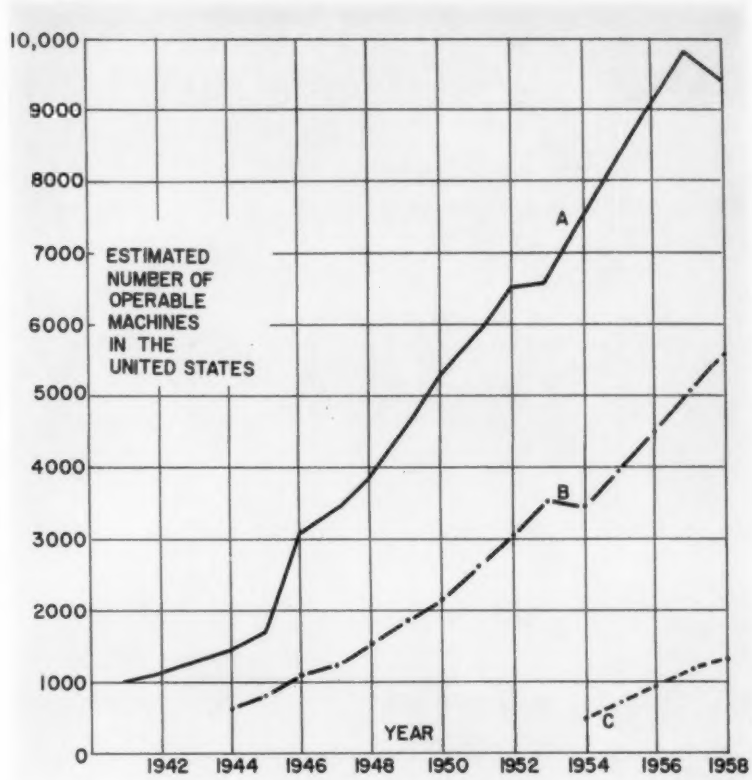
NUMBER OF MACHINES SHIPPED

Heater area, sq. ft.	Domestic 1956	Domestic 1957	Domestic 1958	Export 1956	Export 1957	Export 1958
3 or less	116	126	167	3	12	23
3+ to 6	75	32	44	4	2	4
6+ to 12	37	106	93	2	5	7
12+ to 18	17	15	21	3	1	0
18+ to 30	24	35	24	2	4	3
over 30	1	1	3	0	1	0
All sizes	270	315	352	14	25	37

Table IV: Operable machines in the United States

	1941	1944	1947	1950	1953	1954	1955	1956	1957	1958
INJECTION MOLDING MACHINES										
Year-end cumulative machines shipped	1000[a]	1410	3395	5272	7570	8461	9422	10,479	11,474	12,517
Machines 12 years old or older	—	—	—	—	1000	1092	1248	1410	1656	3075
Operable machines	1000	1410	3395	5272	6570	7369	8174	9069	9818	9442
SCREW EXTRUDERS										
Year-end cumulative machines shipped	—	650[a]	1269	2164	3553	4098	4785	5591	6347	7089
Machines 10 years old or older	—	—	—	—	—	650	833	1107	1269	1556
Operable machines	—	650	1269	2164	3553	3448	3952	4484	5078	5533
SHEET THERMOFORMING MACHINES										
Year-end cumulative machines shipped	—	—	—	—	—	500[a]	700	970	1285	1637

[a] The initial figures were composites of estimates made by persons familiar with the three branches of the industry.



RAPID GROWTH of thermoplastics processing industry is indicated by steep slopes of graphs. Curves assume that injection machines are scrapped after 12 years, extruders after 10 years. Curve **A** is for injection machines, **B** for extruders, **C** for sheet forming machines.

paring rechecks with original reports, were applied to the cumulative figures since this survey began, it being our feeling that the same sources of error had been in operation through the years. The accuracy of this procedure is questionable, but it is undoubtedly in the right direction.

Obsolete machines

Another factor that has never before been considered in this survey is that of retirement of machines from the industry because of wear, breakdown, and obsolescence. At the present time we have no data on the average service lives of these machines. However, we feel that injection machines are not likely to serve, on the average, longer than 12 years, or extruders longer than 10 years. All commercial forming machines are so recent that retirement should not yet be a big factor. Of course, some injection machines in operation are more than 12 years old; on the other hand, some younger ones have been retired. To arrive simply at more realistic figures on the number of operable machines in the U. S., we have arbitrarily assumed that all injection machines 12 years old and more are no longer in operation. The number of operable machines, then, is the cumulative total delivered less the cumulative total delivered 12 years earlier. Both these totals have been corrected for the errors discussed above. The results of these calculations are given in Table IV. The chart above summarizes the rise in the number of operable machines since this survey began at the end of 1941.

The curves of this chart rise smoothly except during a few years, indicating a steady growth in the processing industry. Actually, this growth, in terms of pounds of plastics handled, is faster than these curves would indicate, since machines have become more productive as the years have passed.

The sudden jump in injection machines during 1946 is freakish—some 1420 machines were shipped in that first post-war year, far more than were shipped in adjacent years and a record that's never been equaled. This big year is also responsible for the drop in 1958, since those 1420 machines are now over 12 years old and must be retired. The arbitrary beginning of retirement at 1953 also has its temporary effect on the graph. A similar drop appears in 1954 on curve *B* when the first 10-yr. retirement deduction for extruders is made. Except for these few irregularities, these growth curves are typical of healthy young industries.

From the above discussion of corrections, it should be apparent that the last two digits of the cumulative figures have no significance, but are merely retained to avoid accumulation of rounding errors. Even the hundreds digit is open to question. There are still a few molders who build their own machines, and no allowance for home-made jobs has been made in these figures.

The big gain in shipments of injection machines in the over-55-oz. class comes as a surprise to your editor, who has been predicting the doom of these big fellows for some time. We believe the figure reflects the tremendous upsurge of interest in massive PE housewares and tanks.—END

1958 Engineering Highlights

Brief reviews of important advances in plastics engineering in the past year

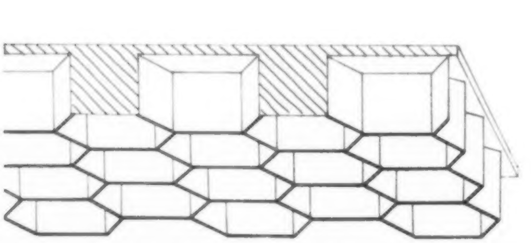
The articles abstracted here were selected from some 30 U. S. and foreign periodicals in the plastics and allied fields. Several good books on these topics have been reviewed earlier, so are not included. Articles on Technical Section subjects, unless they relate directly to plastics processing or application, are also omitted. Interested engineers will find brief comments on such articles in "The year 1958 in review," p. 135.

Design and application

Re-entry of long-range ballistic missiles into the atmosphere, the compression of intake air in jet engines, and the great drag of air on the skins of new high-speed aircraft, all generate very high surface temperatures in the materials involved, causing them to melt, vaporize, burn up, or decompose. The low thermal conductivities of plastics and their ability to soak up heat have brought certain thermosetting compositions to the forefront in these areas. Phenolics reinforced with silica fibers, asbestos, even nylon, actually stand up longer under the tremendous temperatures of re-entry—about 10,000° F.—than any other materials known to men. Three articles on these materials appeared in June 1958. **"NOW . . . into the space age,"** MPL, p. 105, tells what resins and reinforcements have been used in what applications, and why (so far as military security will permit). It also discusses the commercial implications of this business, which, though highly specialized, involves hundreds of millions of dollars (yours and mine). In the same issue, **"Behavior of reinforced plastics at very high temperatures,"** by ***I. J. Grundfest*** and ***L. H. Shenker***, goes into the technical details of testing materials at these temperatures, giving weight loss rates for many compounds. ***M. W. Riley***, in **"Reinforced plastics at 3,000 to 25,000 F."** *Mat. in Des. Eng.*, June 1958, covers, more briefly, most of the same ground.

"Designing stiffness into plastics structures," by ***S. Levy***, MPL *36*, 123 (Sept. 1958).

The relatively low elastic moduli of plastics put them at a disadvantage to the metals in simple structural forms—bars, sheets, etc. However, their easy moldability makes it possible to design complex shapes having high stiffness but requiring no more material than the simple shapes. Thus a plastic shape, which may cost no more to fabricate than a simpler metal shape, may have equal resistance to bending loads but weigh much less than the metal part. The author discusses several approaches to designing for stiffness and gives examples illustrating the surprising power of these methods.



HONEYCOMB RIBBING attached to flat surface makes upper sheet many times stiffer than the thicker solid sheet would be. ("Designing stiffness into plastics structures")

"Tensile and compressive properties of fiberglass reinforced laminates," by ***R. E. Chambers*** and ***F. J. McGarry***, *ASTM Bul.* No. 233, 40 (Oct. 1958).

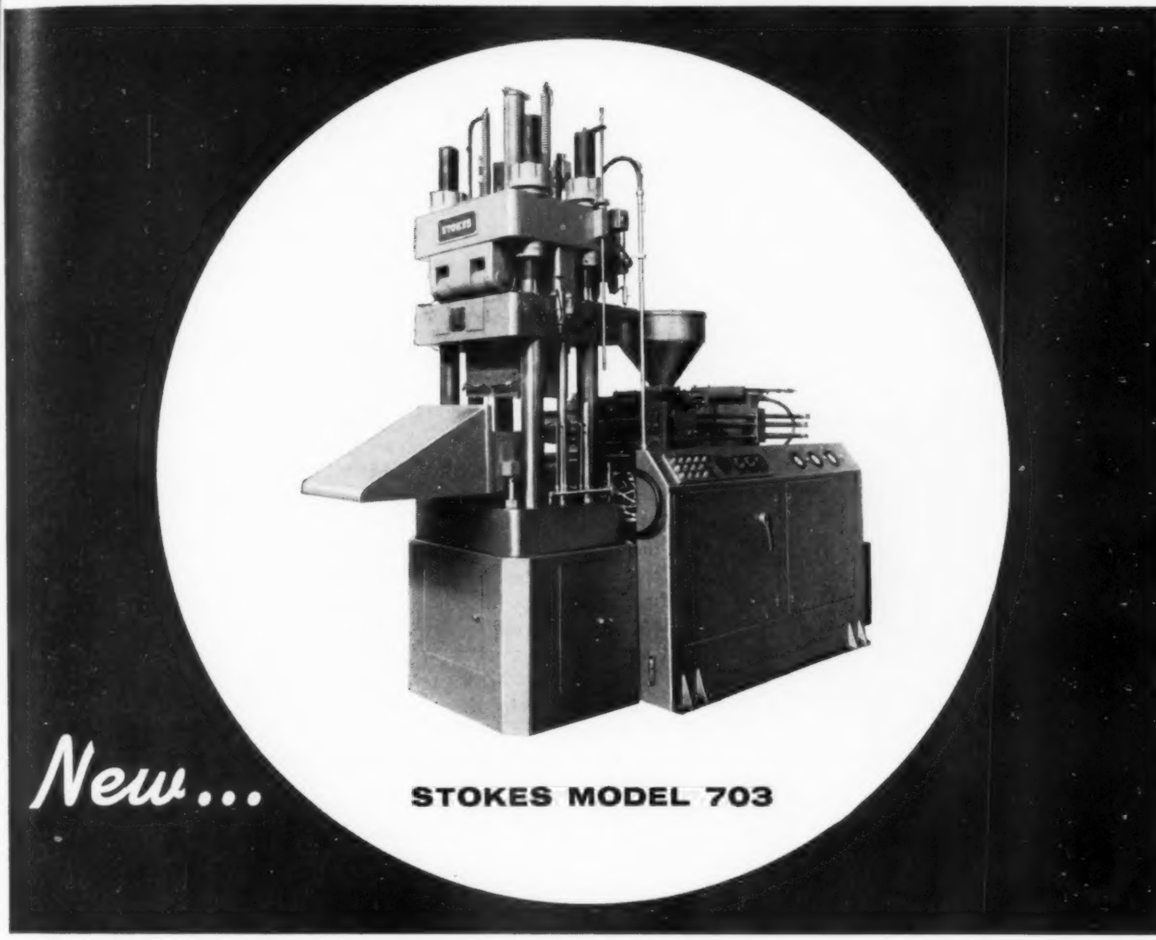
By molding-in strain gages at various points within laminates made of glass cloth and Paraplex P-43 resin, the authors were able to establish that partial failure takes place in the resin phase because of cracking in tension. These failures, occurring at stress levels far below the ultimate strength of the laminate, control flexural behavior. Similar behavior was observed in other polyester and epoxy laminates, and the authors suggest that greater ductility of the resin might substantially raise working-stress levels.

"Properties of cellular polymers," by ***A. Cooper***, *Plas. Inst. Trans. 26*, 299 (July 1958).

This 30-page, data-packed article presents in one place a tremendous amount of comparative design information on all the existing flexible and rigid foams (including those based on rubber, soft and hard). The only properties neglected are the relatively unimportant (for these materials) electricals and chemicals. A veritable foam handbook.

"Importance of fabrication on the properties of silicone-glass laminates," by ***E. C. Elliott*** and ***K. R. Hoffman***, *Pl. Tech. 4*, 235 (Mar. 1958).

The properties of these rugged laminates (flexural strengths on the order of 20,000 p.s.i. at 500° F.) were studied. Effects on properties of resin con- (*To page* 114)



The Truly Automatic 6-ounce Injection Molding Machine

The new Stokes Model 703 is the first machine of 6-ounce capacity to offer truly automatic injection molding to producers of larger parts such as auto tail lights, radio cases, fountain pen barrels, and similar pieces. It provides fast, economical production of big parts, yet is readily adaptable to smaller parts.

The 703 takes full advantage of its vertical design, combining vertical clamping with horizontal combing. Degated parts can be ejected into chutes, or deposited on a conveyor oriented as they were molded. Set-up and change-over is easy and quick—floor space is conserved—the mold is at an efficient working height.

All thermoplastic materials, including nylon, can be molded in the 703. An independently actuated positive nozzle shut-off prevents drooling. It also permits pre-packing the injection cylinder, precompression of the material at high pressure and faster filling. Center-point adjustment of the head insures keeping it absolutely level, preventing cocking of the mold. Automatic lubrication reduces wear and insures trouble-free service. Low pressure and controlled-speed closing provides greater safety to the mold—final clamping is fast, and at full pressure. Push-button type valves on the gages prolong their life.

Technical information and application data is available. Stokes Engineering Advisory Service will assist in the application of the new 703 to your own production needs. Call—or write—today.

Plastics Equipment Division
F. J. STOKES CORPORATION
5500 Tabor Road, Philadelphia 20, Pa.

STOKES

tent (optimum about 30%), washing of glass fabric, fabric strength, catalyst concentration, molding pressure, fabric orientation, and many other factors are reported.

A similar investigation for epoxy-glass laminates was undertaken by ***H. Raech, Jr.***, and ***F. F. Harris:*** **"Optimum aromatic amine - hardened epoxy - glass laminates,"** *Pl. Tech. 4*, 448 (May 1958).

"Creep and stress-rupture behavior of rigid PVC pipe," by ***J. H. Faupel***, MPL 35, 120 (July 1958) and 132 (Aug. 1958).

Results of work directed at the establishment of design principles for plastics under various conditions of static stress and time are presented. It is shown for rigid polyvinyl chloride (PVC) at 73° F. that creep and stress-rupture behavior can be predicted from stress-relaxation data. Various states of stress were obtained by subjecting tubes to various combinations of tension and internal pressure.

"Measuring the abrasion resistance of plastic lenses for sunglasses," by ***P. M. Kamath*** and ***H. O. Buzzell***, *Pl. Tech. 4*, 132 (Feb. 1958).

Using the Polaroid Type B abrader, the authors were able to establish a fair correlation between abrasion resistance in the laboratory and in the field. The laboratory quantity depends on increase in haze (by light scattering) caused by repeated rubbing of lens surface with fine grit. About 90 materials were scouted, four investigated thoroughly in the lab, two in the field. A special coating, S-13 dimethacrylate polymer, had about 12 times the abrasion resistance of polymethyl methacrylate in the lab test. CR-39 allyl carbonate resin was about half as good as S-13.

"Significance of second-order transitions of polyester and epoxy resins in glass fiber-reinforced laminates," by ***A. D. Coggeshall***, *Pl. Tech. 4*, 51 (Jan. 1958).

Glass-transition temperature in laminates, as measured by rate of thermal expansion, corresponds with the first knees in plots of "2-minute loss of stiffness" vs. temperature for these materials. (This quantity is the difference in deflection of a flexural specimen subjected to a given stress at room temperature and at an elevated temperature.) The dependence of this quantity on composition and molding factors was examined, and its relationship to heat distortion temperature (ASTM) was discussed. The latter test has inherent errors leading to too-high values, and is conducted at too low a stress level (264 p.s.i.) to be meaningful for glass-reinforced laminates.

"Insulative and conductive coatings," by ***E. Davis***, *SPE J. 14*, 19 (May 1958), reviews recent developments in resins for electrical purposes. Particularly interesting are the conductive coatings. These are applied in three layers, for surface heating purposes, grounding, etc. Of interest also is a conductive silver/epoxy adhesive developing bond strengths over 4000 p.s.i.; this was reported on in **"Conductive adhesive for electronic applications,"** by ***T. J. Kilduff*** and ***A. A. Benderly***, *Elec. Mfg. 61*, 148 (June 1958).

"Fibrous and non-fibrous insulation for use in high-voltage power equipment," by ***W. J. Renwick*** and ***R. H. Blewitt***, *Plas. Inst. Trans. 26*, 23 (Jan. 1958).

This is a thorough coverage of the factors involved in designing insulating members in high-voltage equipment. Some results of pertinent tests are given for the newer materials. Among these, the epoxies, particularly, offer many superior properties that should enable electrical equipment designers to improve existing designs (which have been ingeniously accommodated to older materials).

"Experience with oil field extruded plastic pipe in 1955," by National Assn. of Corrosion Engineers, *SPE J. 14*, 49 (Feb. 1958).

This is a statistical report on the use of pipe, mostly made of butyrate, PVC, and styrene copolymers, and totaling 165 miles in all sizes. The main subject is failure experience, and the most interesting fact uncovered was this: the five largest users—accounting for two-thirds of the footage—*experienced no failures*. Of the failures, 60% occurred among "test users." Thus it would seem that, in the hands of those who know the capabilities of these pipes, they are dependable materials of engineering. Installed cost of plastic pipe averaged about 15% less than that of steel pipe.

"Plastics can transform agriculture," by ***J. Soyeur***, *Ind. Plast. Mod.* 10, 5 (Jan. '58). (In French)

In the second of two articles, agricultural engineer Soyeur presents much data on the infra-red and UV transmission of vinyl, polyethylene, and nylon (Rilsan) films, discusses the nine major properties of importance for use of these films in greenhousing. In a second article on the forcing of beans, **"Plastics in agriculture,"** by ***F. Buclon***, p. 26 of May issue, there are additional data on the same subjects.

In the Oct. 1958 issue of *Industrial Design* magazine, the editors have written a penetrating survey and analysis of the reinforced plastics industry that should be of interest not only to designers of reinforced plastics products, but also to all those who have a stake in that industry. The report is divided into four parts: 1) a historical review of the industry's growth, 2) the materials used (glass and resins only—fillers, etc., are not discussed), 3) the fabrication technology, and 4) the products, with attention focused on those best suited to the medium.

"Foamed plastics for structural functions in electronic equipment," by ***R. Thielman***, *Elec. Mfg. 61*, 67 (Jan. 1958).

Gives design information for using polyurethane and silicone rigid and flexible foams in protection of airborne electronic gear from vibration, humidity, fungi, salt spray. Vibration aspects are thoroughly treated.

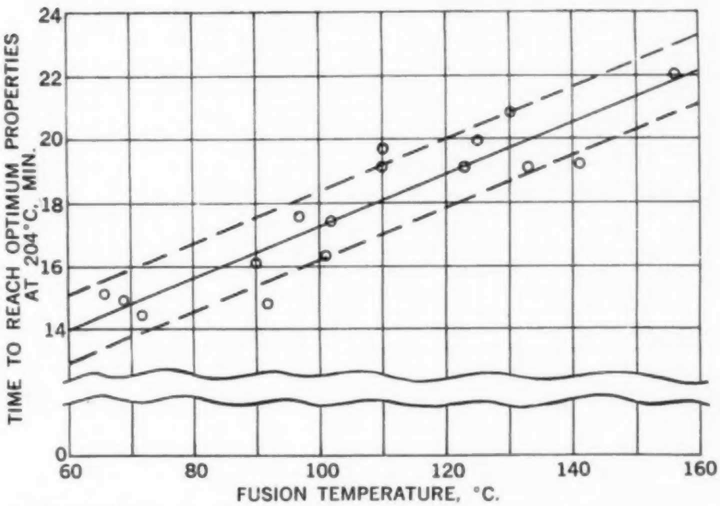
"Engineering aspects of polystyrene," by ***P. H. Estes***, *Pl. Tech. 4*, 644 (July 1958).

A good compilation of engineering design information on the major styrene polymers, includ-

ing treatment of molded-in stresses, environmental resistance, and designing for molding. Only the electrical aspects are neglected.

"Now you can specify plastics pressure vessels," by ***A. J. Wiltshire***, *Mat. in Des. Eng. 48*, 101 (Nov. 1958).

The properties of filament-wound, glass-reinforced epoxy and polyester pressure vessels are reviewed. These spherical vessels are designed—author tells how—to withstand pressures up to 3000 p.s.i. for 10,000 or a million cycles. With rubber linings, the leakage rate of these bottles at 3000 p.s.i. is about 0.1 lb./wk. of air, 0.25 lb./wk. of helium. There is no observable creep at room temperature.



FUSION TIME in commercial-type plastisol molding operation can be predicted rather reliably from the laboratory measurements of the fusion temperature. ("Effect of plasticizers on the fusion of vinyl plastisols")

"Designing with plastics," MPl *Encyc. Issue for 1959, 36*, 20 (Sept. 1958).

This is a brief but comprehensive introduction that covers all aspects of plastics products design. It includes a list of "design questions," many hints for design of molded parts, and a selected bibliography. A supplementary article by *A. M. Blumenfeld* and *S. E. Jones* shows, through the medium of some excellent photos, how light behaves in transparent plastics and how to make good use of this behavior.

Identification of plastics from samples is a recurring problem for which various inadequate solutions have been proposed. A simple and comprehensive procedure for identifying plastics films is given in **"How to tell a film,"** by ***C. L. Blair***, *Mod. Pkg. 32*, 135 (Oct. 1958). The system relies on tearing, burning, smelling, and solvent tests.

"Tensile impact tests on films," by ***R. H. Carey*** and ***M. S. Nutkis***, *Mod. Pkg. 32*, 147 (Sept. 1958).

Impact testing of films and bags has been in such a state of chaos that important producers have been willing to rely on nothing but direct application tests—if a bag is to hold potatoes, then the test consists of loading bags with potatoes and dropping them. In the work reported here, the authors have used the tensile impact test of Bragaw (see MPl for June 1956, p. 199) to bring some order into the field. They show that the product of tensile impact toughness (square root of product of toughness in machine and transverse directions) times film thickness correlates with the bag drop test. Falling-ball tests correlate poorly with both the others.

General processing

"Take your choice of coating methods," by **G. L. Booth**, MPl *36*, 91 (Sept. 1958) and 90 (Oct. 1958).

This two-part article covers thoroughly the factors that enter into choosing a method for accomplishing a particular coating job. It culminates in a clear, concise chart that makes method selection easy.

"Effects of plasticizers on the fusion of vinyl plastisols," by ***L. A. McKenna***, MPl *35*, 142 (June 1958).

A simple and reliable test for determining the minimum fusion temperature of plastisols is described and the results obtained thereby are related to the time required for the plastisols to develop optimum strength properties under the fusion conditions selected. It is shown that the relative viscosity of a plastisol can be used as a guide to the fusion time and temperature that will be required in production.

These data should be of considerable value to plastisol formulators in guiding them to the best plasticizer combination for obtaining a desirable balance between flow properties and optimum production cycles.

"The blow-molding of Rilsan," by ***J. Peynichou***, *Ind. Pl. Mod. 10*, 28 (Nov. 1958). (In French)

A description of blow-molding techniques and equipment. While much of the material presented will apply to any extrudable thermoplastic, the temperatures and other quantitative factors given are particularly intended for nylon-11. Photos of some interesting shapes blow-molded from this material are shown.

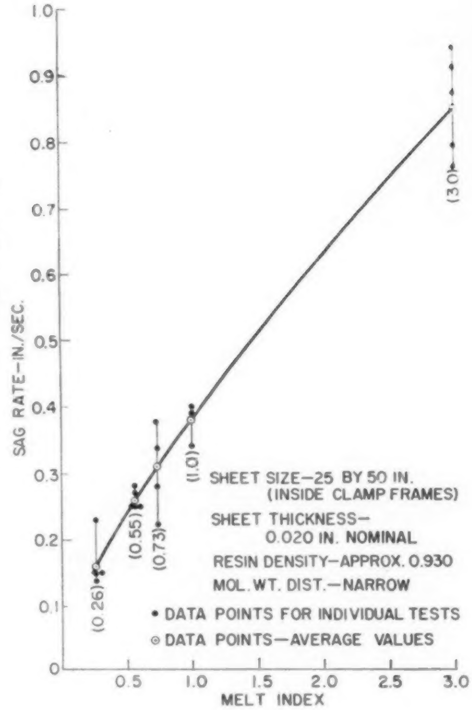
Hardly any branch of polymer processing has been used so long and understood so little as intensive mixing. In an effort to stimulate theoretical thinking on this subject, ***W. R. Bolen*** and ***R. E. Colwell*** presented a speculative paper, **"Intensive mixing,"** *SPE J. 14*, 24 (Aug. 1958). Defining intensive mixing as primarily a process of size reduction of parti-

cles accomplished by shear stress in the surrounding melt, they propose an equation for the rate of size reduction. Flow in a somewhat simplified intensive mixer is analyzed and shear stresses computed for polyethylene under various conditions. One result: only 3% of the input power is spent in the tip region where all the useful size reduction must be accomplished.

"Processing system for optimum design use of casting resins," by ***W. A. Gammel, Sr.***, *Elec. Mfg. 62*, 80 (Sept. 1958).

The difference between failure and success in potting and encapsulation of electrical components may lie in choice and use of the resin-handling system. Various commercial machines for handling these two-component systems are described, with data on molds and working environment. Costs of batch, semi-automatic, and automatic processes are compared.

SAG RATE of sheet versus melt index for polyethylene resins of intermediate (0.930) density and narrow molecular weight distribution. ("Choosing and forming polyethylene sheet")



Coatings consisting partly or wholly of plastics have long been applied to metals and other materials by dipping, spraying, brushing, wiping, and laminating. A new patented method of applying 100%-resin coatings is reported on in **"Fluidized polymer deposition,"** by ***R. L. Checkel***, MPL *36*, 125 (Oct. 1958). The object to be coated is first heated, then dipped into a fluidized, air-agitated bed of fine polymer particles. The sensible heat of the object fuses the adhering particles into an integral, non-porous skin. Equipment and techniques for applying such coatings over metallic substrates by this method are described in the article; several new concepts for plastics fabricating based on the fluidized-bed principle are discussed.

"Modern plastics machinery," by ***O. F. Bartoo***, *Plas. Inst. Trans. 26*, 251 (July 1958).

This is a survey of what is new in plastics processing machinery, with the main attention to fundamentals. The survey is world-wide in scope, and some interesting differences in attitudes in Britain, Continental Europe, and the U. S. are revealed. (There is little innovation in plastics machinery anywhere else.) By 1955, ". . . European machines were not only competitive but in many respects even more modern than the American ones," because Americans are more interested in solid dependability than in innovation. [A consequence of the high cost of maintenance service in the U. S.] Continental operators are the most venturesome of all ". . . taking for granted the minor risk of teething trouble due to the very novelty of the construction . . ."

"A Uni-rotor mixer for rubber and plastics," by ***W. F. Watson*** and ***D. Wilson***, *Rub. Age 82*, 296 (Nov. 1957).

The mixer described is actually a kind of screw extruder having total length of about one-half the lead (ca. 50° lead angle) and dead ended into the bottom of a vertical mixing chamber. Material being mixed is forced downward by drag action, accentuated by reverse twist in chamber walls, and returns by pressure flow. There is no upward leakage, no need for a stuffing ram. Advantages over common two-blade types: wide range of charge size without loss of effectiveness, better temperature control, high energy input, simplicity and low cost of construction. Tapered rotor design permits close control of shear rates over wide range. It seems to this editor that the ratio of high-shear residence time to low-shear residence time is much higher in this mixer than in conventional two-blade mixers. This should lead to much higher efficiency in "intensive" or particle-shearing mixing operations.

Sheet forming

"Choosing and forming polyethylene sheet," by ***A. G. Rowe***, MPL 35, 113 (Aug. 1958).

The thermoforming properties of polyethylene, such as sag resistance and hot strength, are shown to be linked to the fundamental characteristics: melt index, density, and breadth of molecular-weight distribution. Heating and cooling rates at various sheet thicknesses have been investigated, and it was found that with a heater bank of about twice the

usual watt density, polyethylene sheets can be heated rapidly and safely to forming temperatures.

"Sheet formed plastics parts," by ***J. C. Merriam***, *Mat. in Des. Eng. 48*, 121 (Nov. 1958).

This excellent "design manual" reviews the available information on 1) where to use sheet formed parts, 2) how to choose the proper sheet material, 3) choosing the right forming method, and 4) design limitations of the process. There is a good table summarizing pertinent characteristics of commercial sheet materials but, surprisingly, there is no information on costs.

Thermoset molding

"The assessment of cure," by ***A. A. Tomkins***, *Plas. Inst. Trans. 26*, 389 (Oct. 1958).

Molders need a fast method of measuring the degree of cure of thermoset moldings. Several of the methods used are discussed and a case is made for the "hot needle" indentation test, which gives results in a few minutes, and correlates well with the time-consuming acetone-extract test. The development of reliable test apparatus is described and the limitations of the test are discussed. Every thermoset molder interested in knowing and controlling the quality of his products should read this thoughtful piece.

"Elementary calculation of dimensions of compression molds for thermosets," by ***M. Sirtoli***, *Mat. Plastiche 24*, 329 (Apr. 1958). (In Italian)

In compression molding of parts with vertical sides, the normal recommended molding pressure must be multiplied by a (tabulated) factor K given by

$$K = e^{0.0251\ H/S}$$

where H/S is the ratio of depth to thickness of the vertical walls. This minimum effective pressure is thereafter used with simplified stress formulas to compute the minimum mold dimensions for some hollow cylindrical and box-like moldings.

"Flow properties of thermosetting molding powders and their destructive action on molds," by ***A. Lundborg***, *Kunststoffe 48*, 16 (Jan. 1958).

Filled thermosetting resins were molded in steel molds that had been made radioactive. Wear at various points was traced (by determining the activity of the moldings) as a function of powder composition, temperature and pressure of molding, and mold constitution. Conclusions: mold life can be extended 20-fold by judicious choice of material (even within a limited class such as wood-flour-filled phenolics); 4-fold by careful choice of molding conditions; 3-fold by choice of steel or 10-fold by hard chrome plating.

"Best results with phenolic molded parts," by ***D. M. Buchanan***, *Prod. Eng. 29*, 44 (1 Sept. 1958).

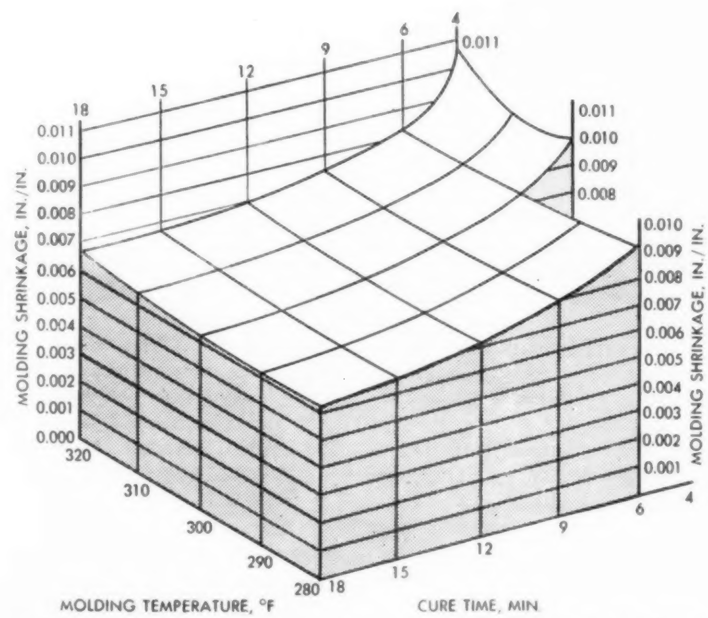
A concise round-up of factors to consider in designing parts to be molded from phenolic. Very informative.

"The dollar value of automated thermoset molding," MPL 35, 85 (Aug. 1958).

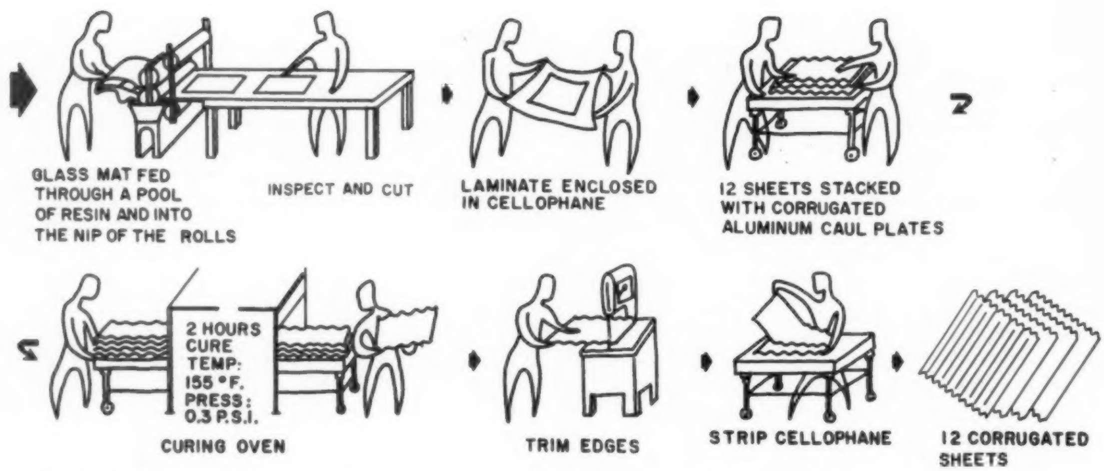
Opening with the gambit that ". . . automation is probably the most misunderstood word today in terms of economics," this article lists 10 points of misunderstanding and gives brand-new production and cost data for automatic and semi-automatic compression molding of parts actually made by both methods. Small, fast, automatics can save much money in labor and tooling and usually have a greater percentage of useful production time than semi-automatics. The thermosets have some unique and valuable properties; this article shows how to mold them at a profit, shows also that full automation is not restricted to big captive shops.

"Molding shrinkage and related effects in a fixed-cavity compression mold," by ***W. R. McGlone*** and ***L. B. Keller***, MPL 35, 125 (Feb. 1958) and 117 (Mar. 1958).

In an extension of work reported earlier, the authors have investigated shrinkage components, both in the force direction and normal to it, as functions of molding conditions and material characteristics. Major shrinkage factors are elastic decompression of the molding and the difference in thermal contraction between the plastic and the mold. Usually minor factors are chemical shrinkage, anisotropy, and inclusion of volatiles. Chemical shrinkage is



EFFECT of cure time and temperature on the molding shrinkage of Diall 50-01. ("Molding shrinkage and related effects in a fixed-cavity compression mold")



FLOW CHART for making corrugated sheets from glass-reinforced acrylic sirup by contact process. ("Reinforced molding with acrylic sirup")

particularly important when cure times are small, because it is essentially a postcuring phenomenon. Shrinkage in the force direction is often different and more dependent upon molding conditions than is the lateral shrinkage. Growth is much more likely to occur in the vertical direction.

Molding shrinkage factors, indispensable in mold design, can be determined with good precision, as illustrated by values for Diall 50-01. Similarly, with the aid of statistical methods, the precision of molding, which sets an ultimate standard of reproducibility in compression moldings, can be determined. The 95% confidence limits of piece diameter for seven typical thermosets range from ±0.19 to ±0.76 mils/in. under the conditions of this study.

Reinforced molding

"Reinforced plastics by 'sprayup'," MPL 35, 119 (Feb. 1958).

The sprayup method centers around a triple gun that ejects streams of resin and glass which meet at a focus outside the gun. The mixture, very uniform in composition, adheres to any surface it strikes. Because mixing is external, very fast-setting resins can be used. Wetting-out is excellent, finished moldings contain less than 1% voids, and mechanical properties are superior to those of moldings made from hand laid up mat. Sprayup offers impressive cost savings both in labor and material. The process is feasible for making all but very small or very intricate moldings.

"Reinforcing epoxy with metal fiber," by ***A. P. Mazzucchelli,*** *SPE J. 14,* 31 (Sept. 1958) and 37, (Oct. 1958).

Reinforcement of epoxy resins with aluminum and steel fibers, sometimes in combination with glass fibers, greatly increases the abrasion resistance, impact strength, heat distortion point, and thermal conductivity of the molded material. The 10- to 50-fold higher conductivity makes it possible to make much larger castings without encountering exotherm troubles. Improved physicals open many new applications in production tooling for forming metals (e.g., for runs of about 100,000 stampings from 25-mil brass sheet).

"Reinforced molding with acrylic sirup," by ***J. A. Ross, B. Mead,*** and ***J. T. Rundquist,*** MPL 35, 109, (Aug. 1958).

A new all-acrylic laminating resin can be used to make such glass-reinforced products as corrugated sheet, flat decorative and structural sheet, and furniture and other complex shapes. Structures made with this new resin have excellent resistance to weathering; thus the product is particularly useful in applications requiring outdoor exposure.

Most of the equipment now used by the industry for molding polyester resins can be used with acrylic sirup for production of articles by the contact process, by press lamination with mat or preform, and by press molding of premix compositions. Certain important process and equipment modifications are necessary, however. The effects of process variables on quality and methods for controlling quality are discussed.

"Physical properties of prepreg laminates," by ***G. Brown,*** *Pl. Tech. 4,* 631 (July 1958).

This study of the effects of resin content and molding factors on the properties of glass cloth preimpregnated with seven resins establishes optimum curing cycles for these materials at 15 p.s.i. molding pressure on 1/8-in.-thick laminates. However, "optimum cure time at each temperature" is not defined, and correspondence between optimum-time plots and the table of data from which they were made is poor. Resin content for greatest flex strength and modulus is between 30 and 35% for all these materials. Eight glass finishes were tested.

"Effects of molding pressure on properties of glass-fiber reinforced plastics," by ***S. D. Toner, I. Wolock,*** and ***F. W. Reinhart,*** *SPE J. 14,* 40 (June 1958).

(To page 120)

Unsaturated polyester laminating resin reinforced with fabric or mat was molded in open and closed molds at various pressures from 1 to 500 p.s.i.g. Tensile, compressive, and flexural properties of dry and wet specimens were measured. Chief conclusion: raising the pressure improved tensile and flex properties of laminates made in open mold, had little effect on those made in closed mold.

Further information of the same general kind was reported by ***A. L. Smith*** and ***W. G. Carson***, **"Influence of resin and process variables on polyester-glass laminate properties,"** *Pl. Tech. 4*, 805 (Sept. 1958).

Fabricating and finishing

"Electronic heat-sealing," by ***R. D. Farkas***, MPL 35, 109 (Mar. 1958).

The theory underlying dielectric heating is reviewed with particular reference to sealing; factors important to machine design and use are discussed in the light of this theory. A good introduction to heat-sealing technology.

An excellent round-up of the principal methods of joining plastics—adhesive bonding, welding, and mechanical fastening—is presented in **"Joining and fastening plastics,"** by ***M. W. Riley***, *Mat. in Des. Eng. 47*, 129 (Jan. 1958).

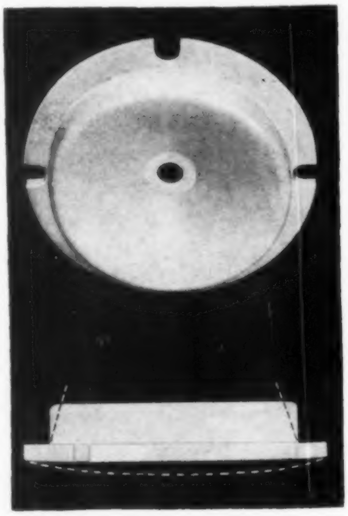
"Recent advances in adhesives," *Ind. Eng. Chem. 50*, 903-938 (June 1958).

Many authors contributed to this symposium, and there is much information, both basic and practical, on bonds between resins and various other surfaces.

A fair amount of information is available on the hot-gas welding and adhesive bonding of thermoplastics, but little on other methods of joining plastics. In **"Joining plastics parts,"** by ***A. J. Cheney*** and ***W. E. Ebeling***, *SPE J. 14*, 31 (Mar. 1958), four other useful methods are discussed. The necessary design information and working techniques for blind riveting (with chemically expanded rivets), press fitting, induction welding, and spin welding are given, though specific data are restricted to Du Pont products.

"Machining TFE resins," by **J. Kipnes**, MPL 35, 123 (May 1958).

Machining of PTFE requires close control of rod stock quality and allowance for the resin's special machining problems: limberness, stress relief, plastic memory, and slow heat conduction. There is much detail here on how to make high-quality parts.



LARGE aircraft antenna insulator, 5½ x ⅞ in., illustrates unusual stress relaxation Teflon can undergo during machining. Starting with base machined to proper flatness, inexperience in generating concave face would give rise to bowing of base and the face becoming more concave. Both flat and concave faces must be machined using sequences that will compensate for these stress-relief characteristics. ("Machining TFE resins")

"Bonding of Teflon," by ***E. R. Nelson***, ***T. J. Kilduff***, and ***A. A. Benderly***, *Ind. Eng. Chem. 50*, 329 (Mar. 1958).

A new process for rendering TFE resin bondable consists of immersing the plastic in a solution of sodium-naphthalene complex in tetrahydrofuran. Directions for preparing bath, which is stable for two months and need not be chilled or vented, are given. Bond strengths with epoxy resin of 1100 to 2000 p.s.i. (tension or shear) were achieved with 1-min. pretreatment.

"Printing on films," by ***P. Absalom***, *Can. Pl.*, p. 46 (Jan. 1958).

A summary of information on effective printing and drying procedures, and printing inks, for the common plastics films.

"Adhesive bonding of the newer plastics," by ***M. J. Bodnar*** and ***W. J. Powers***, *Pl. Tech. 4*, 721 (Aug. 1958).

This is a report on the bonding of nine new plastics to metals and to themselves with a variety of adhesives. The polysulfide-epoxy adhesive (not identified) seemed most versatile, and bond strengths achieved were in the range 600 to 1900 p.s.i. in shear, and up to 2260 p.s.i. in tension. Polyolefins would not bond without chromic acid pretreatment, and this also improved bond strength to Delrin (polyoxymethylene).

"Heat-sealing of thermoplastics by means of infra-red radiation," unsigned but attributed to ***M. Gournelle***, *Mat. Plastiche 24*, 432 (May, 1958). (In Italian)

Other methods of heat sealing are briefly reviewed, then a description of the new infra-red technique is given. Much space is devoted to emission and absorption characteristics, respectively, of infra-red sources and plastics. All the common packaging films, including Mylar, have been sealed with this equipment (pictures shown), but working cycles for various thicknesses and widths are not given.

"Construction of containers and tubes from Hostalen [high-density polyethylene] using a winding method," by ***G. Schulz***, *Kunststoffe 48*, 37 (Jan. 1958).

Large hollow cylindrical (and perhaps polygonal) bodies can be economically made by winding hot extruded strip onto collapsible forms. The strip is about 4 in. wide by 0.2 in. thick, welds to

(To page 124)

At Eastman

the question of color in plastic

has over 39,000 creative answers

Eastman's Leadership in Color Creativity Has Produced Tenite Plastics in a Range of More than 39,000 Colo

To get an answer, you have to ask a question.

Users of Tenite plastics have asked enough questions since 1932 to make it necessary for Eastman color technologists to create formulations that will soon total 40,000 different colors and color effects.

While an untrained person may think of colors only in terms of the basic spectrum, his eyes usually are perceptive enough to detect even a minute variation when two colors are placed side by side. To such an eye, a new automobile interior would look disturbingly "wrong" if there were the least bit of difference between the color of its upholstery and its matched plastic appointments such as steering wheels, arm rests or control knobs.

Accurate color matches, therefore, are a vital concern to all manufacturers of plastic products that must be used in harmony with other colored materials of different surface texture, density or reflectivity such as painted wood, enameled metal, colored tiles or textiles. And, as color becomes more important in product design and merchandising because of its sales-stimulating effect, the attendant problem of proper color matching becomes even more critical.

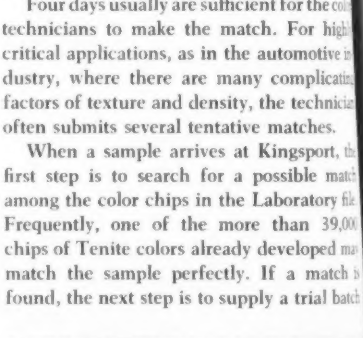
Since 1932, when Eastman began to produce plastics, it has developed and kept on file, formulations for over 39,000 colors. This experience, plus Eastman's pre-eminence in color photography and textile dye technology, makes it possible for customers to depend on Eastman for the broadest range of colors available in the entire plastics industry.

In many instances, of course, customers can solve their color selection problems merely by consulting the extensive files of color chips available at every regional Tenite sales office. More extensive research in color matching can be carried out at the Tenite Color Laboratory in Kingsport, Tennessee. Here, the user of plastics is invited to work out his color problems in cooperation with a trained staff of color technicians.

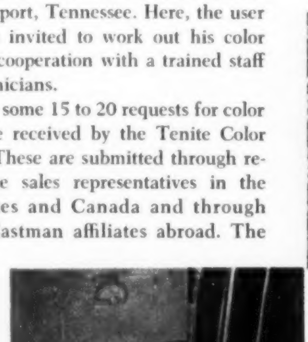
Every day, some 15 to 20 requests for color matching are received by the Tenite Color Laboratory. These are submitted through regional Tenite sales representatives in the United States and Canada and through numerous Eastman affiliates abroad. The color samples submitted for matching inclu almost every known material — textil metals, tiles, wood, rubber, other plasti paint and many more.

Four days usually are sufficient for the col technicians to make the match. For high critical applications, as in the automotive in dustry, where there are many complicatin factors of texture and density, the technicia often submits several tentative matches.

When a sample arrives at Kingsport, th first step is to search for a possible matc among the color chips in the Laboratory fil Frequently, one of the more than 39,00 chips of Tenite colors already developed ma match the sample perfectly. If a match i found, the next step is to supply a trial batc

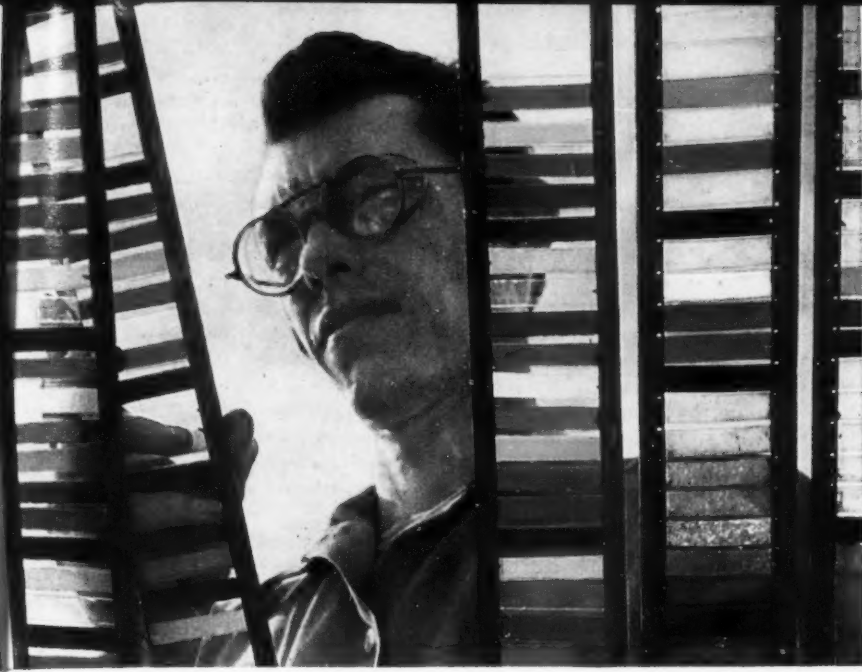


Thousands of colors on file



Milling the trial color

Accelerated weather test



Color creativity depends on color research

of colored Tenite pellets to the customer.

When no formulation on file permits a match, the Laboratory proceeds to create a new color formulation. The technician first takes advantage of Eastman's 26 years of past color creativity—by selecting existing color chips of the nearest color matches and noting their colorant formulations. These provide him with helpful references for which there is no substitute. Drawing on the performance of colorants in many previous tests and in their actual finished or processed state, the technician avoids time-consuming delays of trial and error. He is assured that the colorants are easy to disperse, are compatible with the plastic mass and the plasticizer, and that they possess the maximum resistance to migration and the attacks of time, light, weather and temperature that limitations of availability will permit.

As he weighs out the colorants to make the new match, the technician varies the formulations of the nearest matches, adjusting them to approximate the exact color needed. When variegated, pearlescent or metallic effects are wanted, the technician must deal with the result of combining the components as well as with the color match. Often, he relies on intuition—disciplined by years of experience—to create a totally new and striking effect for the customer.

In the next operation, components of the formulation are blended together on milling rolls to insure homogeneous dispersion. Color chips are then molded from this test batch, and evaluation begins.

If surface coloration is the only critical factor, visual or "eyeball" inspection usually suffices to confirm the match. But even here, the technician must bring his highly specialized judgment into play. He must consider the visual implications of the two textures and their psychological effect in determining acceptance of the color in plastic as the proper match for the color in another material. In addition, over-all size and shape as well as contour of the original sample complicate his color matching efforts.

When light transmission is to play an important role in the end-product, the technician turns for conclusive guidance to the spectrophotometer. This precision instrument measures the length of light rays, and its findings permit formulation of properly translucent colors when transmission ratings must be held within limits dictated by the end-use.

If the color fails to duplicate the sample either by "eyeball" or spectrophotometer testing, the matching process starts all over again.

Finally, when the color technician is satisfied that the color match is accurate and that it can be supplied in commercial quantities within the prescribed limits of commercial acceptability, he makes a detailed record of the new formulation in the Tenite Color Laboratory file.

Careful detailing of the formulation is one of the most important steps in the color matching operation—for the success of full-scale production depends upon the accuracy with which the formulation has been recorded.

With the writing and filing of the formulation, another customer has had his color question answered—*and another color has been created by Eastman.*

The full story of the color resources that back up the Eastman plastics—Tenite Butyrate, Tenite Polyethylene and Tenite Acetate—is told in a 20-page booklet, "COLOR." For your free copy or more information on these plastics, write to EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

Judging the match

TENITE

BUTYRATE • POLYETHYLENE • ACETATE

Colorful plastics by Eastman

adjacent strip as it is wound. After cooling, the form, which must be internally braced against the cooling-contraction of the polyethylene, is knocked down and removed. Typical products of the process: large pipe, 55-gal. drums, garden swimming pools, silos, and tanks.

"New method for bonding polyethylene to rubber, brass, and brass-plated metals," by ***H. Peters*** and ***W. H. Lockwood***, *Rub. World 138*, 418 (June 1958).

Untreated polyethylene (of any density) is bonded to rubber and brass with a partially hydrogenated polybutadiene (Phillips Hydropol), temperatures from 150 to 232° C. and pressures up to 100 p.s.i. Bonds so made have tensile strengths up to 1000 p.s.i., peel strengths from 60 to 100 lb./in. The variations in bonds strengths with brass composition, per cent unsaturation and sulfur content of polybutadiene, bonding conditions, and rubber formulation were investigated. New method eliminates many-layer bonds formerly necessary.

Extrusion

"Screw extrusion theory with applications to double-base propellant," by ***M. L. Jackson, F. J. Laracot***, and ***H. R. Richards***, *Ind. Eng. Chem. 50*, 1569 (Oct. 1958).

The theory of solids flow in extruders is developed and applied also to semi-solid flow, which has many of the characteristics of solids flow. Pressure development is exponential with channel length. Short deep screws are used with propellants. Design of extruders for propellant compacting is discussed.

"PVC dry blend extrusion," by ***E. H. Hankey*** and ***R. D. Sackett***, *SPE J, 14*, 43 (Mar. 1958).

This experimental study of wire-coating with vinyl dry blends in a 2.5-in. extruder (valved but not vented) tested the importance of such factors as screw speed, thread depth in metering section, relative length of screw, die pressure on extruder output, stock temperature at die, power consumption, and extrudate quality as measured by fish-eyes and porosity. We suspect that many of the quantitative results could have been calculated from simple flow measurements. However, quality is better with longer screws, at higher screw speeds and die pressures, and with screws having shallower flights than are used for standard PVC compound. Dry-blending procedure can significantly influence porosity in unvented extruders.

"Extrusion of clear film from high density polyethylene," by ***R. Doyle***, *SPE J. 14*, 35 (June 1958).

Polyethylene of 0.96 density and melt index=5 can be extruded from a flat-film die and water-quenched immediately to yield a film having excellent clarity (ASTM haze=5%), high stiffness and strength, high operating temperature limit (sterilizable at 250° F.), and the "easy-opening" character of cellophane. Production equipment and procedure are described, along with typical film properties.

"Screw-extruder pumping efficiency," by ***P. H. Squires***, *SPE J. 14*, 24 (May 1958), presents simplified shape factors for melt flow in "deep" screws that approximate 1-dimensional flow estimates for end effects and effect of channel curvature. Drag-flow equations were confirmed to within ±5% by experiments in deep 2-in. diameter screws. These simple shape factors should make it easier for any extruder to estimate performance of his equipment more accurately.

"Comparative data on extrusion machines," *Pl. Tech. 4*, 819 (Sept. 1958).

Essential specifications are given of all commercial extruders. Like the publication's molding machine survey, there is much data in little space. It is obvious, however, that some disagreement exists among the various makers as to how to rate bearings and working strengths of barrels.

A similar compilation, less specific as to individual machine details but covering extruder makers throughout the world, was prepared by the editors of *Brit. Plas. 31*, 282 (July 1958). This was made more interesting by printing a photo of one machine from each maker.

"Techniques and equipment for extrusion," *Brit. Plas. 31*, 276 (July 1958), consists of three articles by ***A. Kennaway, E. A. O. Mange, E. G. Fiher***, and ***W. A. Maslen***, plus a machinery survey by the editors. All three articles are surveys. The first is an assessment of the present state of extrusion, the second of equipment design and control, and the third of the elements of die design.

"Some aids to the design of dies for plastics extrusion," by ***D. L. Weeks***, *Brit. Plas. 31*, 156 and 201 (Apr. and May 1958).

The design of extrusion dies is still considered pretty much of an art in the trade. In an excellent two-part article, the author has brought together most of existing die design *science* with some new ideas of his own. In particular, he has somewhat simplified the application of the power law of melt flow to design of manifold sheeting dies. Also, he discusses the testing of dies by experiments in geometrically similar dies made of transparent materials, and gives rules of similitude governing such experiments with Newtonian liquids.

"Non-Newtonian flow in annuli," by ***A. G. Fredrickson*** and ***R. B. Bird***, *Ind. Eng. Chem. 50*, 347 (Mar. 1958).

Annular flow is involved in all pipe and wire-coating dies. In this article equations are given for the flow of Bingham and power-law liquids (plastics melts) through annuli in terms of certain shape functions. The functions are tabulated, so pressure drops and flow rates in such systems can be calculated.

"Screw extrusion of granular 'Fluon' polytetrafluoroethylene powder," by ***E. M. Elliott***, *Plastics (London) 23*, 8 (Jan. 1958).

The author describes an apparatus for the continuous extrusion of tubing and wire coatings of PTFE that consists of a water-cooled, double-flighted, long-lead screw and a long, heated die. The powdered resin is compacted and

forced, still relatively cold, into the die where sintering occurs. Rates are comparable with those obtained by ram extrusion and quality of wire coating is reported to be better. Samples of coaxial cable 5/16 in. in diameter have been wound around a 1-in. mandrel and heated to 250° C. (482° F.) for an hour, then air cooled, with no signs of cracking.

"Experimental determination of velocity profiles in an extruder screw," by ***S. Eccher*** and ***A. Valentinotti***, *Ind. Eng. Chem. 50*, 829 (May 1958).

Using a screw extruder with a glass sleeve and a transparent fluid containing aluminum particles, local velocities relative to the screw were determined with a microscope in an axial section of the groove, under several output conditions. The transverse component was independent of output. At no output, there is a stationary layer at two-thirds of the height of the channel. The drawings showing the velocity distributions are clear and beautiful.

Injection molding

Most exciting development in injection molding reported this year is precompressed molding, i.e., holding back the flow of melt into the mold cavities until the ram has brought the material in the cylinder up to full pressure. The "explosive" decompression of the melt when the valves are opened magnifies filling rates tremendously—to six times the normal or more. Thin sections are filled more easily, with less residual stress, on shorter cycles. Often, the technique permits reduction in cylinder temperature or nominal ram pressure. In multi-cavity molds the technique requires either hot runners or multiple nozzles. In the first case, quick-opening valves replace the normal gates in the mold, in the second the valves are located in the nozzle. Sequencing the valves amplifies the effect even further with very little lengthening of the cycle. The first method was described in **"Valve gating of injection molds,"** by ***A. Spaak*** and ***G. Kelly***, MPL *36*, 117 (Sept. 1958), the second in **"Sequential impact molding,"** by ***G. D. Gilmore*** and ***J. Decker***, MPL *36*, 187 (Nov. 1958).

"Determining the economic optimum number of cavities," by ***J. C. Goettel***, *SPE J. 14*, 32 (July 1958).

The author presents a formula for calculating this often needed number, then discusses its limitations. The formula is

$$x = \sqrt{\frac{At\,(H_0 - Wy\,x_0)}{60\,CE}}$$

where x = the optimum number of cavities for lowest over-all cost (= parts/shot).

H_0 = the hourly cost (*not* rental price) of a small "base" machine, \$/hr.

W = additional machine capacity needed for each additional cavity (= 1.5 × piece weight), oz./cavity.

y = rate of increase of hourly cost with machine size, \$/hr., oz.

x_0 = the number of cavities used with "base" machine.

A = total number of parts to be molded.

t = molding cycle, min./shot.

C = cost for each additional cavity over base x_0, \$/cavity.

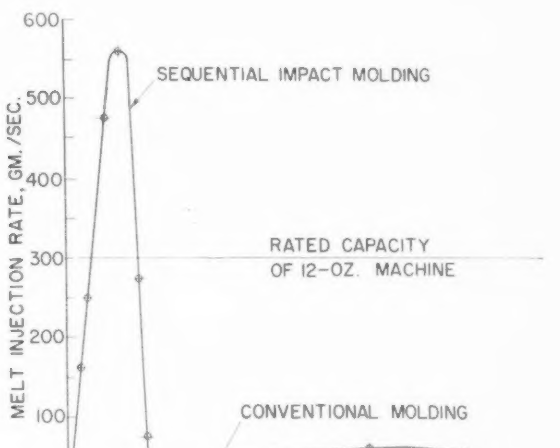
E = machine efficiency = fraction of total machine time during which salable pieces are made.

Since the formula assumes that the variables y, C, and E remain constant as x changes, it will be most accurate when the "guess-timated" base number x_0 is close to the calculated optimum x.

"Planned plant for automatic molding," by ***L. A. Ulmschneider***, MPL *35*, 121 (June 1958).

Here is a description of a plant designed for the automatic molding of photographic sundries. Tooling, plant layout, quality control and safety programs, and materials handling in this plant can serve as a model for anyone contemplating large-scale production of molded items.

"Molding quality control and some aging characteristics of nylon," by ***S. R. Prosen***, *SPE J. 13*, 28 (Dec. 1957). Working with 6/6 nylon (Zytel 101), the author found that the incidence of brittle failures (negligible tensile elongation before break) ranged from 1 to 60%, increasing with rising cylinder temperature, mold temperature, and rate of pulling. Small variations in mold-open time in otherwise time-controlled cycles resulted in large variations in percent brittleness, which was sharply reduced when time was carefully controlled. Aging ex-



FILLING RATE graphs for two half-gallon containers molded under identical conditions by sequential impact molding and by conventional means. ("Sequential impact molding")

periments confirmed in detail the known moisture-pick-up behavior of this resin. Tensile strength diminishes linearly with moisture content from about 10,500 p.s.i. for bone-dry specimens to 5200 p.s.i. for ones containing 8% water.

"Conical heat chambers," by ***R. T. Wheeler***, *SPE J. 14*, 27 (Feb. 1958)

The author discusses the design of a heating cylinder whose inner diameter increases slightly toward the forward end. The torpedo has been designed to 1) minimize dead spots, 2) provide a constantly decreasing cross section for flow, thus reducing bridging and pressure loss, and 3) facilitate dissassembly. In a six-month production run with PVC and polystyrene, the new design operated at lower ram pressures and faster cycles than the standard cylinder it replaced. Heat-transfer area of standard cylinder was 92% of that of the new one.

It is often advantageous for injection molders to color their molding powders to their customers' orders, and every molder would be delighted if he could simply drop a shot of pigment in with each shot of molding powder and get an evenly tinted piece out the other end. Where coloring requirements have been stiff, many persons have resorted to extrusion compounding before molding. A compromise widely used is "dry-coloring," in which the pigment and molding powder are tumbled together before being fed to the machine. This often leads to streaky products, so molders have hopefully cluttered their cylinders and nozzles with "dispersion aids" to improve coloring uniformity. This year three reports on such devices were published.

In **"Molding dry-colored polyethylene,"** MPL *35*, 97, (July 1958), ***C. L. Weir*** reports on the performance of a number of special nozzle designs, breaker plates, and nozzle inserts. With the aid of transmitted-light photos of molded disks, he shows that conventional breaker plates do almost no good, even when used two-in-series. Commercial nozzle inserts were also rather ineffective. But a new breaker plate design using many venturi-shaped holes accomplishes coloring uniformity equal to that obtained by extrusion compounding. A similar plate, but using only one venturi hole, was proposed by ***J. E. Simpson*** in **"A new breaker plate for coloring polyethylene,"** *SPE J. 14*, 27, (Mar. 1958). This plate exacts a considerably higher penalty on molding pressure than the multihole plate, however. ***J. N. Scott***, ***C. J. Silas***, and ***J. V. Smith***, in **"Dry-coloring methods for injection molding of polyethylene,"** *Pl. Tech. 4*, 552 (June 1958), reported about the same results with the standard devices as did Weir. They proposed a double breaker plate of their own design that gave improved distribution of color, though not as good as the Weir plate gave, it seems.

"Comparative data on injection molding machines," *Pl. Tech. 4*, 442 (May 1958). Basic data on current standard models offered by nearly all the U. S. makers. These five pages can replace stacks of company literature in your files.

"Molding linear polyethylene," by ***A. Spaak*** and ***C. L. Weir***, MPL *35*, 122 (Apr. 1958).

The effects on distance of flow into a spiral mold of changes in molding conditions were measured for linear polyethylenes (PE) of several melt indexes and compared with results for branched PE and high-impact polystyrene. They show that the linear polymer is more reluctant to flow than the others, and its flow is less sensitive to changes in ram pressure and melt temperature than is the flow of branched PE. Mold cavities can be pinpoint-gated if cold flow front in runner is diverted from gate entrance to a dead ring surrounding the gate. Recommended for best results: differential cooling of mold cavity areas to get uniform cooling times; generous sprues, runners, and gates; high filling rates (preplasticator helps); and melt temperatures between 375 and 550° F. Higher temperature degraded the polymer in this study; however, the residence time was unusually long here because the shot size was very small. Mold temperature should be the highest that will be consistent with an economical production cycle time.

To make a profit, a plastics processor must operate in a businesslike manner. Prices must be based mainly on costs, and ignorance or neglect of costs has cost many a molder his shirt. Accountant ***W. H. Nussbaum***, in **"Cost estimating: injection molding,"** MPL *Encyc. Issue for 1959, 36*, 30 (Sept. 1958), explains how to set up a rational cost-finding and estimating system for injection molding, and how to set prices. Sample data sheets that include all cost elements are shown. Realism is vital. For example, many molders argue that their handling loss of materials is negligible, whereas tests showed that actual losses average 2.7%, range from 1.2 to 40 percent.

"Connection between properties and molding methods of thermoplastics," by ***M. Chatain***, *Ind. Plas. Mod. 10*, 45 (May 1958). (In French)

This is a well executed study of flow in mold, and of molded-in stresses. Test samples were taken from pieces molded under various conditions and impact resistance (Dynstat apparatus) measured as a function of the angle between the directions of flow and of testing, the distance from the point of injection, and cylinder temperature. Cellulosics, acrylic, Rilsan, polystyrene, and three styrene copolymers were investigated. In the direction of the flow, impact strength drops with increasing distance from gate, while remaining constant in the perpendicular direction. The drop-off is steep at low cylinder temperatures, gentle at high ones (300 to 460° F. for polystyrene-butadiene resin). In the second part of this work (June issue, p. 37) the polystyrene compounds were investigated further. Test specimens were cut from a box-shaped molding, and the influences of injection temperature and direction of testing on tensile and flexural strength, elastic modulus, impact strength, and shrinkage on annealing were determined.—END

MACHINERY AND EQUIPMENT

Specifications, claims made, and prices appearing in these pages are those of the manufacturers or sellers of the machinery and equipment described, or their agents.*

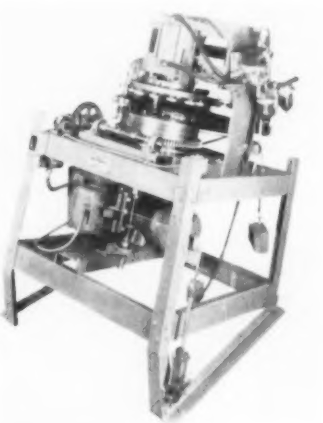
Long-stroke molder

The L-225 6/9-oz. Lester offers an especially long stroke in its class, adjustable from 8 to 16 inches. Maximum daylight is 38 in., mold clearance between beams is 20 in. horizontal, 17.4 in. vertical. The machine comes equipped with three die-thickness spacer rings. Clamping tonnage is 225.

Nominal shot size is 6 oz. with single feed, 9 oz. with double, in polystyrene, and the machine has produced 12-oz. shots of styrene copolymer. Minimum dry cycle time with 8-in. stroke is 4 sec.; 5 sec. with 16-in. stroke. Plasticating capacity is 150 lb./hr. of GP polystyrene. With a special attachment, the L-225 will mold nylon neatly. For the first time on a Lester, the entire injection cylinder retracts 12 in. for purging and maintenance. Other features include a 200-p.s.i. hydraulic system, S.P.I. standard ejection, low-pressure closing, and automatic cycling. *Lester-Phoenix, Inc., 2711 Church Ave., Cleveland 13, Ohio.*

Flash trimmer and contour former

An automatic trimmer can remove flash from any molding that has a continuous parting line in one plane (this includes most injection and compression moldings). The machine can also be utilized for contour forming. A carbide-tipped, rotary cutter is guided by a contour follower around the edge to be cut. No cams or platen forms are needed. Some idea of the machine's capabilities may be gained from its performance on molded toilet seats and lids. Seats were deflashed and contour-formed inside and out on a 10-sec. cycle, while lids were trimmed in 6 to 7 seconds. *Gaynes Engineering Co., 1642 W. Fulton St., Chicago 12, Ill.*



GAYNES TRIMMER and contour former with machinery guards removed to show the details of the mechanism.

Drum tumbler

The Tumble-Master is a heavy-duty drum rotator that can handle one or two drums 28 to 38 in. high. Drums load into brackets at floor level, eliminating lifting, and are locked into adjustable bracket with quick-opening, positive lock. *Ball & Jewell, Inc., 22 Franklin St., Brooklyn 22, N. Y.*

Die-cutting press

The Models D-2436 and D-3050 die cutting presses have built-in heat-assist that makes it possible to trim formed oriented polystyrene without shattering the pieces; it also leaves a cleaner edge on other materials. The air-hydraulic action is powered by any central compressed air supply (80 p.s.i. or higher). The trimming area is 24 by 36 in. for the D-2436, 30 by 50 in. for the D-3050. Accurate micrometer stops permit controlled penetration of low-cost steel-rule dies. This eliminates expensive bed finishing, gives longer die life. Either press will cut multiple blister or skin packs with draws up to 12 inches. Prices: $4,750 and $6,850, complete with shuttle table. *Tronomatic Machine Mfg. Corp., 1881 Park Ave., New York 35, N. Y.*

Drum deflasher

An end-loading drum deflasher removes flash from extrusions and moldings and separates finished products from flash. Operation is simple and automatic. A power loader dumps 400 lb. of parts into the loading hopper from which they are fed into heavy-duty wire-mesh drum. At the end of the cycle, during which the flash falls through the screen and is chuted away, the drum stops and reverses its rotation for unloading. In one case, a load of screw-driver handles is deflashed in five minutes. Drive is a 1-hp. Gear-head motor turning drum at 20 r.p.m. The equipment works well on thermoplastics and thermosets. The 400-lb. unit (about 8 cu.ft. of work per batch) costs about $3850 plus $1550 for the power loader. Other sizes can be had. *Ransohoff, Inc., N. Fifth St. and Ford Blvd., Hamilton, Ohio.*

Spray-painter and mask washer

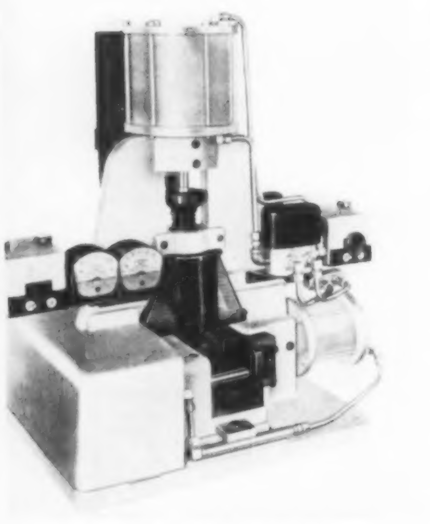
A machine that automatically washes and dries used masks while next part is being painted is said to be the first of its kind. Clean masks are supplied as often as needed without having to have a large inventory of masks. Tests indicate production can be increased 25% over that achieved with separate mask washer. The machine is expected to be especially valuable to those who are using masks with fine detail or who are spraying heavy coatings that soil masks quickly.

When mask being used needs washing, operator indexes rotating plate to which four masks are attached. The soiled mask goes into the washer, the second mask moves to a second washing station, the third is blown and dried, while the fourth indexes to the spraying position. Any of the three basic spraygun movements can be installed in five minutes and areas up to 6 in. square can be painted. *Conforming Matrix Corp., 364 Toledo Factories Bldg., Toledo 2, Ohio.*

Miniature injection molding machine

The Pro-1-57 Little Giant injection molder is a compact, completely automatic machine of 1/3-oz. capacity. It will operate on 100- to 125-p.s.i. line air pressure, developing a top ram pressure of 7000 p.s.i. at 125 p.s.i. on the line. Plasticating capacity is about 6 lb./hr., heater wattage is 650, operating temperature range is from 100 to 650° F., with control to ± 1° F. Mold dimensions are 3.5 in. high by 5.2 in. long, by 2.5 in. thick, with 2.2 in. of daylight (mold open). Maximum molding area is 5 sq. in. The mold clamp develops (*To page 130*)

*Prices are deemed to be F.O.B. sellers' plants (unless otherwise stated), are for "standard" models, and are subject to change without notice. The publishers and editors of MODERN PLASTICS do not warrant and do not assume any responsibility whatsoever for the correctness of the same, or otherwise.



STOKES mill for plastics, available in three sizes, will granulate, pulverize, mix, disperse, etc.

7000 lb. at 125 p.s.i. line pressure. The bench model weighs only 195 lb.; legs are available. Dry cycle speed ranges from 50 to 500/hr., with higher speeds available on special order. The tiny mold is fitted with an ejector plate, stripper screws and pressure springs, to accomplish automatic ejection. Price of bench model with blank mold and mold temperature indicator is $1031. *Simplomatic Mfg. Co., 4416 W. Chicago Ave., Chicago 51, Ill.*

Guillotine cutter

The 24-in. Jaco Autogil cutter is modeled after the 15-in. model described here in April 1958. Maximum thickness that can be cut depends on density of material, but may be as great as 3/16 inch. The new cutter, which cuts roll stock up to 24 in. wide, is available in two types. Type S is meant for cuts up to 8 in. long, while Type L cuts lengths up to 96 inches. Price is approximately $2100. *Hobbs Mfg. Co., 26 Salisbury St., Worcester, Mass.*

Pipe puller

Model 1200-2 pipe puller is a side-loading take-off for extruded rod and tube that can handle any diameter from 1.5 to 12 inches. Three sets of rollers are used, spaced at 120° intervals around the pipe. Each set consists of five neoprene rollers 5 in. in diameter by 1 in. wide. The two bottom sets are driven by a 1-hp. U. S. Varidrive at take-off rates ranging from 0.9 in./min. to 20 ft./min. A single toggle lever opens or closes the unit, simplifying loading and permitting fast clearance of jams. Pressure exerted by top rollers may be adjusted from zero up, so unit is well suited to take-off of thin-walled tubing. It comes with tachometer, remote control station, height adjusters, and built-in winch for start-up. Price is $5,400 (F.O.B. Bell Gardens). *Al-Be Industries, 6103 Clara St., Bell Gardens, Calif.,* and *The Rainville Co., 224 7th Ave., Garden City, N. Y.*

Heat sealer for big pieces

Continuous lap sealer makes overlapping seals in film and sheeting materials such as PVC, polyethylene, impregnated fabrics, and the like. It is expected to be most useful in the manufacture of agricultural covers, storage basin liners, tarps, and other items for which stock must be joined in continuous lengths. The overlap seal assures great reliability under outdoor exposure and heavy stresses. The machine, in effect a split-band sealer, comprises two sealing sections, one above and one below the material. Pairs of sealing bars and water-cooled bars are provided as required for the application. A device to apply solvent as an aid to sealing is optional. *Doughboy Industries, Inc., New Richmond, Wis.*

Compacting presses

Hydraulic multipresses in capacities from 2 to 75 tons are said to provide precise, automatic control of all phases of compacting and pelleting operations. Chief advantages of these presses are 1) they eliminate scrap loss, 2) uniform fill and density because pressure is applied at both ends, and 3) adjustable fill feature that allows adjustment even while press is operating. The basic unit consists of the press itself, a shuttle feed unit with agitator, a synchronized ejection ram, and the control system. *Denison Eng. Div., American Brake Shoe Co., 1160 Dublin Rd., Columbus 16, Ohio.*

Automatic web tension control

This device maintains constant tension in any web as it leaves the unwind roll, regulates the tension through other processing steps, and controls tension as web is rewound. Set up in three simple steps for any given operation, this low-maintenance controller is adaptable to all web handling machinery. "Split-second" response senses tension changes of as little as 1 ounce. Control circuits are air-operated. *Mount Hope Machinery Co., 15 Fifth St., Taunton, Mass.*

Saw-tooth crusher

The Model 250 AA "crusher" was specifically designed for the reduction of warm plastic stock, but will also crush many tough and brittle materials. The rotors are 25 in. long by 16 in. in diameter, are fitted with sets of intermeshing saws having 16 teeth each. These teeth are 5/16 in. thick, hard-faced, accurately ground. Special combs incorporated in the machine prevent jams, are made of non-ferrous metal and shear-pinned to their supports. Rotors are driven at different speeds by gears enclosed in oil-tight casing. *Sprout, Waldron & Co., Inc., 130 Logan St., Muncy, Pa.*

Thermoforming machine

The Model A-14, Style 4 vacuum forming machine incorporates many of the features of the parent Model A-14, has built-in vacuum pump, air compressor, tanks, and motors. A high-speed blower cools formed product. An unusual feature is the machine's up-moving vacuum platen supporting the perforated mounting plate. This motion makes possible deep drawing with assists and drape forming. Forming area is 14 in. square, greatest draw is 6 inches. Unlike its predecessors, the Style 4 machine is automatically controlled —can feed itself from rolls, form, and eject without requiring constant attention. Three timers control the forming cycle. *Atlas Vac-Machine Corp., 1732 Hudson Ave., Rochester 6, N. Y.*

Duplex slitter and doctor

Model 182 combination slitter and doctor machine is designed for high-speed rewinding and multiple slitting of films, coated papers, foils, and the like. Its open-end construction is designed for easy, one-man loading. Shafts accommodate rolls up to 18 in. in diameter, 30 in. in width. Slitting speeds up to 1000 ft./min. are possible, with side register guaranteed accurate to ±0.10 inch. Drive may be either 3 or 5 horsepowers. Features include: tachometer-controlled magnetic drive, automatic vacuum-controlled constant tension, and web guide. *Stanford Engineering Co., Salem, Ill.*

Heating tanks for plastic strippable coating resins

These tanks are especially designed for heating ethyl cellulose, butyrate, and strippable coatings, that require high, accurate operating temperatures. Proper temperature is maintained by a heated oil jacket surrounding the entire compound chamber and by constant agitation and circulation of the melt. These tanks also have a premelting chamber that supplies new melt to maintain constant level in the dipping chamber. The tanks are *(To page 132)*

suitable for either hand or conveyorized dipping of items to be coated. *D. C. Cooper Co., 1467 S. Michigan Ave., Chicago 5, Ill.*

Web winder drive

The redesigned Temco constant tension winder drive is completely enclosed in an iron tank to make it compact and leakproof. It is designed for use with either an existing windup stand or as part of a complete unit by the drive maker. It can wind many types of material in various widths and thicknesses at a wide choice of tensions. These units are being offered in sizes ranging from 1.5 to 100 hp., can handle webs at speeds up to 6000 ft./min. over a roll build-up range of 100:1. *Sealol Winders, Inc., 23 Post Rd., Providence 5, R. I.*

Vacuum metallizing filaments

A new design of twisted tungsten filament wire for metallizing chambers has open strands instead of being tightly twisted as before. Also, a stronger form of the metal is being used. These changes are reportedly adding up to 80% to the life of filaments. Open strands are reported to have more exposed area per unit length, can hold more molten aluminum, are less likely to develop hot spots. *General Electric Co., Components Dept., Nela Park, Cleveland 12, Ohio.*

Close-tolerance press

The series 200 Atlas presses have been especially designed for extremely accurate control in research and testing, it is claimed. Precise tolerance can be maintained in either molding or laminating of plastics because the slab-side frame is extra-heavily built and 45° bronze guides give accurate platen alignment. These presses are available in platen sizes from 12 in. square to 24 in. square. Platens are available with steam or electric heating, and water cooling. The hydraulic system of the press can be driven either by compressed air or by an electric motor-and-pump system. *Atlas Hydraulics, Inc., 3576 Ruth St., Philadelphia 34, Pa.*

Large mask washer

The Model W-4200 mask washer is designed particularly for washing large paint-spray masks up to 42 in. in length, such as are used in producing refrigerator and automotive trims, large toys, advertising displays, etc. It is equipped with a nonferrous, splash-proof lid, sight glass, adjustable mask suspension, and pump intake strainer. It requires 50 gal. of solvent for efficient operation. Non-clogging nozzles direct spray against both sides of masks to be washed for thorough but gentle cleaning. *Conforming Matrix Corp., 364 Toledo Factories Bldg., Toledo 2, Ohio.*

Versatile mills

The Tornado line of mills is offered for granulating of thermoplastic and thermosetting molding compounds, pulverizing, mixing, dispersing, etc. Material is ground and mixed by a cluster of whirling blades attached to a common vertical shaft. These create a centrifugal airflow that throws the material against a cylindrical screen that completely surrounds the rotor. Streak-free color blending is readily accomplished. Wet and sticky materials, as well as heat sensitive materials can be processed. Screen size, number, and spacing of blades—all easily changed—are chosen for job at hand. The mill disassembles quickly for cleaning. Working parts are of stainless steel. Motor horsepower depends on kind of work being done; speed is varied by switching drive belt to any of three pairs of pulleys. The mills are offered in three sizes. Number 0 unit has a 10-in. rotor, requires drive of approximately 3 horsepower. Nos. 1 and 2 use about 10 and 30 hp., respectively. All are mounted on casters. *F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.*

LITTLE GIANT automatic injection machine has ⅓ oz. capacity; bench model weighs only 195 pounds.

Slitter-rewinder

The Model BD-S-24 duplex slitter-rewinder features slip clutches that operate on a spinning reel principle to minimize tension. Tearing of newly slit films during rewind, long a headache, is eliminated by the new machine. Material is fed through the machine by a pair of nip rolls whose pressure is adjusted manually. The rewind shafts, therefore, need only exert enough tension to insure a uniform roll. An additional feature that has been incorporated into the equipment is a patented core design that permits each rewind roll to operate independently of the others so as to compensate for across-the-sheet variation in film thickness. *Doven Div., Appleton Machine Co., Appleton, Wis.*

Small injection molding machine

Improvements in the Model 75 4-oz. automatic injection molding machine are claimed to result in greater operator convenience, closer control, and reduced maintenance. The new model features all plug-in controls, with control voltages of only 110 instead of 220. Pumping capacity and operating speed have both been increased. Clamp linkage has been provided with a cushioning mechanism that is anticipated to increase machine life. A new feed hopper, made of magnesium, has been designed to provide a more uniform powder feed. *The Moslo Machinery Co., 2443 Prospect Ave., Cleveland 15, Ohio.*

Hot stampers and accessories

The Hercules Acroleaf press comes in four models, all designed to hot-stamp in color with roll leaf onto plastics, fabrics, paper, etc. Die areas range from 2 by 2 in. to 6 by 6 in., with daylights (under 1-in.-thick die) of 4 to 8 inches. Roll-leaf feed is automatic, with feed increment adjustable to 0.01 inch. Temperature can range from 100 to 500° F., is automatically controlled. Stamping is done by hand lever or handwheel, with spring return micrometer-stop mark control. The manufacturer of the press will also supply dies and type if desired. Price of smallest model is $275.

A supplemental head for the Acromark 250H model provides an increase in stamping area to 12 by 2.5 inches. This head is interchangeable with the standard one, is suited to hot stamping gold, silver, or colors on large areas. Using 100 p.s.i. air, the press exerts a stamping force of 2.4 tons. Throat depth is 8 in., stroke is 4 in., daylight is 9.5 inches. Complete with accessories needed for conversion, new head is priced at $658. *The Acromark Co., 5-15 Morrell St., Elizabeth, N. J.*—END

The

NEW

PRODEX

HENSCHEL

MIXER

THE NEW PRODEX-HENSCHEL MIXER

is used successfully in many installations here and abroad to prepare compounds ready for extrusion and molding, such as: **unplasticized rigid PVC dryblend, plasticized PVC dryblend, polyethylene colorant powder mix, cellulose acetate dryblend, PVC record compound, etc.**

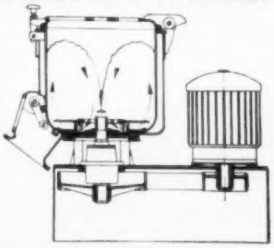
The PRODEX-HENSCHEL MIXER performs intensive dryblending and thorough dispersion of colors, pigments, fillers, stabilizers and/or plasticizers with plastics powders or granules.

It permits, if desired, the mechanical (frictional) heat-up of plastics powders faster and more uniformly than by conduction or radiation.

The unique principle of fluidizing dry powders so that they can be mixed like liquids, plus controlled shearing action, result in mixing quality and mixing speeds heretofore not obtained.

Design and Operation of the PRODEX-HENSCHEL MIXER

A cage-like ring of pins rotates concentrically around a stationary ring of pins. The rotating member also carries specially shaped blades and impellers which aerate and propel the powders to be mixed. The action is similar to that of a high-speed stirrer. The aerated powders or granules flow downward through the center of the rotating ring and pass through the zone of shearing between the rotating and stationary pins. The blend then moves upward along the wall of the mixing chamber. The entire batch rotates slowly around the axis of the mixing chamber. The rotating member of the mixing mechanism is usually operated at peripheral speeds of 100 to 200 ft/sec. The spacing between the rotating and stationary pins determines the shearing action. The shearing action controls mixing and dispersion as well as mechanical heat-up.



NEW APPLICATIONS OF THIS NEW MACHINE ARE FOUND DAILY. INVESTIGATE HOW IT COULD INCREASE THE EFFICIENCY OF YOUR PROCESS. ARRANGE FOR A DEMONSTRATION WITH YOUR MATERIAL.

PRODEX

PRODEX CORPORATION

FORDS, NEW JERSEY · HIllcrest 2-2800

Manufacturers of Process and Extrusion Machinery

ASK FOR BULLETIN M1

Dr. Gordon M. Kline, Technical Editor

PLASTICS* TECHNICAL SECTION

MATERIALS • PROPERTIES • TESTING METHODS AND INSTRUMENTATION • STANDARDS • CHEMISTRY

The year 1958 in review

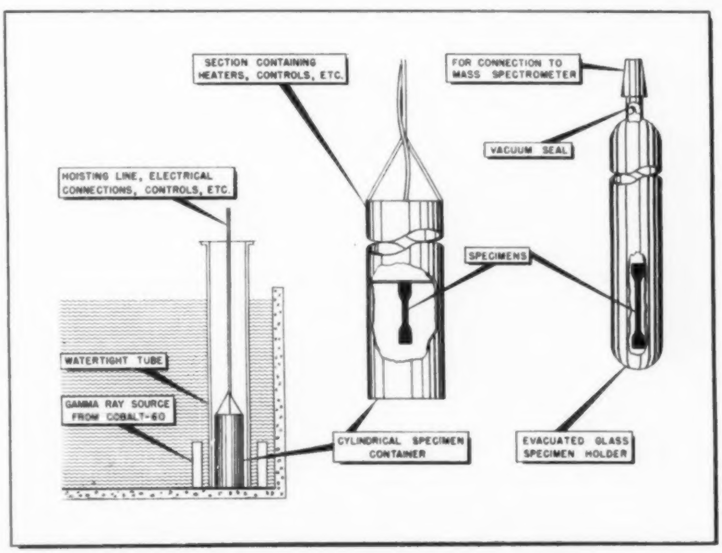
Consolidation of pilot plant work and market development on the new materials announced in the two preceding years was the keynote of progress in plastics during 1958. Further advances in the technology and application of polyformaldehyde, polycarbonates, chlorinated polyethers, polyethylene oxide, linear polyethylene, and polypropylene are presented in this review and in recent surveys (1, 2).[1]

Two outstanding contributions to the science of polymerization were reported during the year. One describes the formation of condensation polymers, such as nylons and polyurethanes, at the boundary surface between aqueous and organic solutions. This interfacial polycondensation makes polymers in a few minutes at room temperature and atmospheric pressure. Special equipment such as is required for the hot melt process is not needed; laboratory beakers are suitable. In addition, high monomer purity and exact balance of reactant monomers are not essential to attain high molecular weight products (3). Development of soluble catalysts for the production of highly linear polyethylene with superior impact and tensile strengths represents a notable achievement in the field of addition polymerization. The removal of insoluble Ziegler-type catalysts from polyolefins, such as polyethylene and polypropylene, has been a difficult and costly operation. The new catalysts are made in one case from tetraphenyltin, aluminum chloride, and vanadium chloride (0.1%) and in another by the reaction of bis(cyclopentadienyl)titanium dichloride with diethylaluminum chloride. The use of these soluble catalysts has the advantages of conducting the polymerization in a homogeneous system, thus requiring much less catalyst, and yielding a virtually unbranched PE of narrow mol. wt. distribution (4, 5).

Stimulated by the possibilities of forming active sites on polymers by radiation as well as by chemical means, a new technology is developing for the preparation of graft and block copolymers which yield plastics, rubbers, films, and fibers having built-in properties of two or more basic materials (6-14). For example, the problem of dyeing polypropylene fibers can be solved by grafting on thin layers of polymethyl methacrylate (15). Graft polymerization on polyethylene (16, 17) and natural rubber (18, 19) and block polymerization in systems composed of acrylamide with acrylonitrile and acrylic acid (20) and butyl acrylate with styrene and vinyl pyridine (21) were investigated.

Radiation

The potential importance of radiation processing and radiation resistance of plastics was reflected in the continued emphasis given to this subject in research laboratories (22). One especially comprehensive investigation determined the correlation between chemical and physical changes occurring in gamma-irradiation of polycarbonates, polyethylenes, polyfluorocarbons, polyesters, polystyrenes, and polyvinyl chlorides; the aromatic-type carbonate, polyester, and styrene materials were the most resistant to damage by radiation (23);



RADIATION SOURCE and arrangement of specimens used in investigation (Ref. 23) of effect of gamma rays on several plastics materials.

* Reg. U. S. Pat. Off.
[1] Numbers in parentheses link to references at end of article, p. 181.

other reports dealt with radiation effects on polyethylene (24-29), polyesters (30, 31), polyvinyl chloride (32-34), polycaprolactam (35), polymethyl methacrylate (36), elastomers (37-39), polyacrylonitrile (40), polyamides (40), starches (41), cellulose (42), four types of packaging films, namely, styrene, ethylene, cellulosics, and polyethylene terephthalate (43), and six types of polymeric coatings, namely, alkyd, epoxy, fluorocarbon, phenolic, silicone, and cellulose nitrate (44). Reviews were published covering trends in radiation processing, sources of radiation, processing variables, and economics of radiation operations (45, 46), and radiation effects on materials (47-50).

LONGEST CAST acrylic sheet (Ref. 55) being installed as an outside curtain wall panel over plywood sheathing of an office building.

Materials

Acrylics: A new all acrylic resin in sirup form has been developed for use in reinforced plastics. The use of reinforced acrylic is particularly attractive where both decorative qualities and weatherability are desired (51). An optimum combination of unsaturated polyester, styrene, and methyl methacrylate for exterior applications of glass-reinforced panels was established (52). New techniques were described for the production of reinforced (53) and thin-walled (54) parts by thermoforming of acrylic sheets. Twelve-foot long panels used for exterior facing material for an office building are reported to be the largest cast acrylic sheets ever produced (55). Acrylic pistons for food processing equipment (56), a worm feed for moving corrosive slurries (57), and a phosphoracrylic matrix for fast neutron detection (58) were developed. A solventless anionic-polymerized room-temperature-curing adhesive based on a cyanoacrylate monomer shows promise for use in the rapid bonding of components made of a wide variety of materials (59).

Reports of research on acrylic derivatives related to alkyl acrylates (60, 61), acyloxyacrylic esters (62, 63), alpha-methylbenzyl methacrylate (64), allylic methacrylates (65), methacrylic esters (66), polyacrylamides (67-70), polyacrylonitriles (71-73), and polymethyl methacrylate (74-76). Vulcanizable saturated acrylate elastomers were described (77). Studies were conducted on the dynamic mechanical properties of poly-*n*-butyl methacrylate (78), and accelerated fatigue testing (79), fracture phenomena (80), anelastic creep (81) and deflection under load of circular plates (82) of polymethyl methacrylate. Other investigators reported on thermal degradation of polyacrylonitrile (83) and polymethacrylonitrile (84), dielectric studies (85, 86), crystalline structures (87), alkaline hydrolysis of polyacrylates (88), and dilute solution properties of poly-*n*-hexyl methacrylate (89). A method was described for determining ethyl ester polymers in methyl methacrylate copolymers (90).

Cellulosics: Problems in the storage of cellulose nitrate were discussed (91, 92); other studies of this material pertained to thermal (93) and ultrasonic (94) degradation, and chemical groups formed during nitration (95-97). Cellulose acetate film coated on one side with a pressure-sensitive adhesive is available for pressless laminating of documents, leaves, and similar specimens (98). Various authors reported on physical and chemical properties of cellulose acetate (99-103), ethyl cellulose (104-108), cellulose tributyrate (109), and new esters and ethers of cellulose (110-113). The degradation of cellulose derivatives by heat (114), light (115, 116), and gamma radiation (42) was investigated. Acetylated starch is being used as a sizing for paper (117). Recent developments in lignin chemistry and technology were reviewed (118).

Epoxies: Production of epoxies in 1957 was estimated to be 40 million lb. (119). Novolac, glycerol, and peroxide epoxies (120), dicyclopentadiene dioxide and vinylcyclohexane dioxide (121), and a glass-fiber-filled molding compound (122) were among the epoxy materials described in the literature (123-125). Effects of various fillers on strength (126) and electrical (127) properties were reported. Bis(aminophenyl) sulfones (128), aromatic amines (129), and boron trifluoride (130) were proposed as curing agents for epoxy resins (131, 132). Precautionary measures are needed in handling some epoxy systems to avoid dermatitis (133, 134). Epoxidized esters serve as plasticizers and stabilizers for polyvinyl chloride (135-138). Methods for determining epoxide groups (139) and alpha-glycols (140) in resins were described. Other authors dealt with electrical (141-143), mechanical (143, 144), and thermal (145) properties, and chemical resistance (146).

Tools for metal-forming (147-150), encapsulation of electronic components (151-156), protective coatings for metal products (157-161), and multipurpose adhesives (162-165) continue to be major applications for epoxy compounds. Glass-reinforced epoxy cantilever-type leaf springs for vibrating conveyors were reported to be superior to those made of steel and plywood (166). Large potential markets are foreseen for epoxy resins in highway and building applications, including sealing membranes, high-friction surfaces, cast traffic reflector buttons and markers, adhesive repair compounds, masonry and pipe coatings, and surfacing compounds (167).

Data were presented (168) on epoxy cryogenic structural adhesives at temperatures of −423 F. (liquid hydrogen). An epoxy resin with em- (*To page* 138)

bedded rubber thread grid provides a new medium for experimental stress analysis (169).

Ethylenes: Production of polyethylene passed the 700 million lb. figure in 1957 and is forecast to reach the 1200 million lb. mark in 1962 (170). The complex relationships between density, melt index, molecular weight, molecular structure, crystallinity, and physical properties were discussed in several noteworthy articles (171-174). The preparation, properties, and compounding of the various polyethylenes were reviewed (175-184). The tremendous impact of the discovery of the important role of various catalytic systems in controlling the properties of polymerized ethylene was reflected in the large number of research reports on such systems (4, 5, 185-194).

The modified techniques required for molding (195-199) and extrusion-forming (200-204) of the high-density polyethylenes were described. Slush molding, a process long in use with vinyl plastisols, has been adapted to blends of low-molecular-weight and standard low-density polyethylene (205). Improved methods were reported for dry-coloring (206-208), printing (209), bonding (210-212), and heat-sealing (213) of polyethylene.

A big new market for polyethylene film has been developed in the dry-cleaning business which uses about 900 million bags annually; a special machine bags garments in 15 sec., eliminating bag inventory and waste coverage (215). Polyethylene has become the dominant material in the molded housewares field (216). In competition with metals, cement, and clay, polyethylene pipe offers advantages of reduced labor cost, light weight, and corrosion resistance; consumption is expected to reach 85 million lb. in 1960 (217, 218). Development of machinery and film for a bread wrap that is 25 to 35% cheaper than cellophane (219) highlighted advances in the packaging uses of polyethylene (220-223). Other applications reported include tote boxes (224), marine accessories (225), motor insulation (226), moderator core for nuclear reactors (227), protective coatings (228, 229), rubber compounding (230), water-softener tanks (231), hoops (232), and pistol cartridge cases (233).

X-radiation provides a means for nondestructive testing of polyethylene moldings for voids, cracks, metal, and particles which might cause premature failure (234). Techniques were described for prediction and detection of weathering damage (235, 236). Data were published on mechanical (237-241), electrical (242), and permeability (243-245) properties of polyethylene, and bursting strength life of polyethylene pipe (246, 247). The molecular characteristics (248-253) and crystallinity (254, 255) of polyethylenes received widespread attention.

Polypropylene: Start of production of polypropylene under the trade name "Pro-fax" by the Hercules Powder Co. in a 20-million-lb. capacity plant followed immediately upon the announcement in last year's review of the availability of Montecatini's "Moplen" (256). Further information on the properties of this new plastic was presented in the 1958 literature (257-263).

POLYETHYLENE FILM garment bags have found wide acceptance (Ref. 171) by dry cleaning establishments as well as the public.

Fluorocarbons: A resin produced by copolymerization of tetrafluoroethylene and hexafluoropropene is easier to extrude than polytetrafluoroethylene; it can be blown to form bottles and yields films that can be heat-sealed (264-266). A copolymer of vinyl fluoride and hexafluoropropene provides a thermally stable elastomer (267-270). Reports on polytetrafluoroethylene gave helpful information on designing (271), machining (272), and bonding (273), its uses in fibers (274), lubricants (275), coatings (276), packaging (277) and machine parts (278, 279), and its thermal stability (280) and fine structure (281). The preparation and properties of polychlorotrifluoroethylene (282-284), perfluoroalkyl propenyl ketones (285), and perfluoroalkyl acrylamides (69) were described.

Isocyanate polymers: Total isocyanate consumption in 1957 was estimated to be 6 million lb., with growth expected to reach 12 million lb. in 1958 and 40 to 50 million lb. by 1960. Flexible polyurethane foam production in 1957 was estimated at 12 to 18 million lb. and rigid foam at 2 million lb. (286). Many new combinations of polyesters and polyethers with isocyanates to produce polyurethanes were reported (287-289). Detailed information was published on the preparation of polyurethane foams (290-294) and their applications in the automotive (295), electronic (296-298), and refrigeration (299) industries. Developments in urethane compounds for protective coatings (300) and rubber-type applications (301-304) were reviewed; both markets are estimated to be under 1 million lb. at present, but offer promise for rapid growth. Slabs of urethane foam were used as seed-beds for growing flowers (305).

Phenolics: Materials that feed uniformly, preheat readily, and flow and cure rapidly have been developed for automatic molding

to offset rising labor costs (306). This and other developments in compounding (307-310) and designing (311-313) are serving to keep phenolics above the 500 million lb. production figure first reached in 1955. Materials for applications as coatings (314-316), adhesives (317-319), and ion exchange resins (320) were described. Other reports dealt with the preparation of specific phenolic resin systems (321-323).

Polyamides: Combinations of polyamides with epoxies, isocyanates, phenolics, polyesters, ureas, melamine, and chlorosulfonated polyethylene are undergoing investigation for use in coatings, adhesives, body solders, potting compounds, and inks (324, 325). Polymers based on caprolactam (326), unsaturated compounds (327, 328), and undecanoic acid (329, 330) were described. Light weight, toughness, and dimensional stability are important factors in the expanding markets for nylon moldings (331-336), film (337), tubing (338), and sintered nylon parts (339). A nylon-asbestos laminate is reported to resist 2000° F. for 5 min. (340). Designing (341) and extruding (342) of nylon parts were discussed. Studies of properties of polyamides covered dynamic mechanical behavior (343-345), static friction (346), degradation (347, 348), fusion characteristics (349), and viscometry (350).

Polyesters: A new polyester film that is amorphous and nonoriented was announced; it is intended primarily as a laminating film where weatherability, adhesion, abrasion resistance, and ease of processing are required (351). An air-supported factory housing 30 employees has a covering fabricated of nylon-fiber-reinforced heat-sealed polyester film (352). Various reports dealt with film (353, 354) and fiber (355, 356) made of polyethylene terephthalate. Syntheses of polyesters from a wide variety of raw materials were described (52, 357-360). Styrene-modified polyesters resistant to intermittent exposures to 500° F. were reported (361). Electrical insulation represents an important market for polyester moldings (362, 363). Noteworthy papers pertained to curing evaluation (156, 364), thermal stability (365), heats of fusion (349), and adhesion of polyester resins to glass surfaces (366). Infra-red absorption spectrometry proved useful in the analysis of polyesters (367-372).

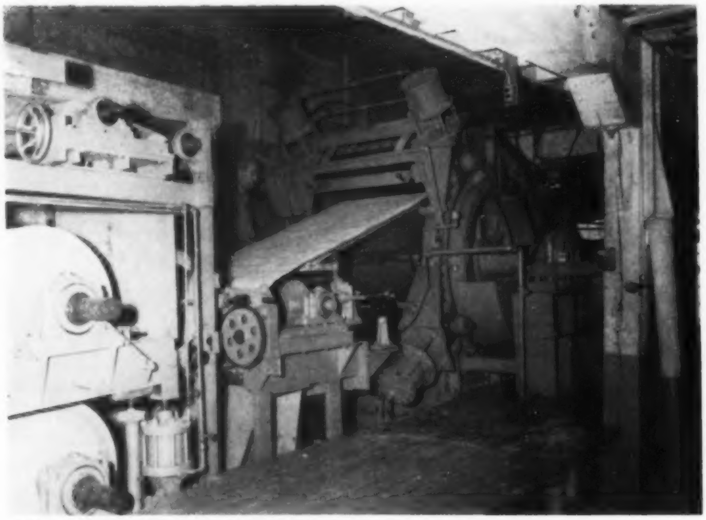
Styrene polymers and copolymers: An antistatic styrene injection molding compound contains an additive that imparts sufficient conductivity to the surface to neutralize charges which otherwise attract dust particles (373). Safety measures were prescribed for handling styrene monomers (374). Notable applications of polystyrene occurred in battery containers (375), lighting fixtures (376), housewares (216), phonograph records (377), containers (378), and chromatography (379, 380). High-quality dinnerware is being injection molded by three molders using a styrene-acrylonitrile compound; it is reported to be resistant to staining and to washing in automatic dishwashers (381). Acrylonitrile-butadiene-styrene copolymer has been selected for the production of 105-mm. howitzer shell cases for field tests; the plastic case weighs half as much as present brass or steel cases and has successfully withstood firing tests at gas pressures of 6000 to 35,000 p.s.i. and momentary flame temperatures exceeding 4000° F. (382). This ABS plastic was also employed in a variety of other applications requiring toughness and light weight (383-387). Many papers were published on the polymerization of styrene compounds (61, 320, 388, 389) with particular reference to ionic catalysis (390, 391) and on the stability (392-394), engineering (395), and molecular characteristics (66, 396-398) of styrene polymers.

Vinyl polymers and copolymers: Production of vinyl plastics in 1957 approached 900 million pounds. Rigid vinyl pipe and sheeting production in 1957 was estimated at 25 million lb. with a 70 million lb. consumption anticipated in 1965; the chemical processing industries and oil, gas, and water lines are primary consumers (399). Vinyl-clad metal jumped from 1 million sq. ft. in 1955 to 18 million sq. ft. in 1957

CHEMICAL-RESISTANT vinyl glove (Ref. 412) shown at left is made by dip coating on supporting fabric. The sculptured dipping form used is at right.

with an expected growth to 140 million sq. ft. in 1960; primary uses are in the building, transportation, television, luggage, and furniture industries (165, 400, 401). Clear vinyl sheeting 0.14 in. thick was used for the transparent wall, 1000 ft. in circumference and 42.5 ft. in height, of the U. S. pavilion at the Brussels World's Fair (402). A 52-ft.-diameter globe formed by inflating vinyl-clad nylon fabric served as a planetarium theater with a seating capacity of 150 persons at the Brussels Fair; such air-supported structures are being used for military shelters and warehouses. The basic vinyl-nylon fabric is challenging the dominance of canvas in the tarpaulin market (403). Other important uses for vinyls were developed in piping (404-406), coatings (407-409), packaging (410), belting (411), records (377), chemical-resistant gloves (412), underground drainage systems (413), as well as a variety of specialized applications (414-416).

Effects of plasticizers (417-419) and particle size and uniformity (420) on processing and properties of vinyl compounds were described. Developments were reported in electronic welding of film (421), calendering (422), extrusion (423), and coating, printing, and embossing fabrics (424). Noteworthy contributions were made on creep and stress rupture behavior of rigid PVC pipe (425), low temperature brittle-



CONTINUOUS FORMING of fibrous mats (Ref. 519) represents an important advance in the production of uniform materials for laminates.

ness (426), degradation mechanisms (427-430), permeation (431-433), heats of polymerization (434), surface phenomena (435), crystallinity (436), and molecular weight (437) of vinyl polymers. Vinyl pyrimidines (438), vinylene carbonates (439-441), vinylidene chloride copolymers (60), vinylamines (442), vinyl stearates (443), vinyl methyl ethers (37), vinyl acetates (444, 445), and vinyl acetals (322, 446) were among the vinyl derivatives prepared and characterized. Many studies of polymerization of vinyl-type monomers were reported (447-450). A method was described for the determination of lead in PVC products containing lead stabilizers (451).

Other polymers: More data were published regarding the new polymers described in the 1957 review, namely, polycarbonates (452-456), polyethylene oxides (457-459), and aromatic polyanhydrides (460). Wood-flour-filled urea molding compound is considered to offer promise as an economical and superior arc-resistant material in wiring devices and closures (461). Methods of analysis of urea, melamine, and urethane resins were reported (462-464). Properties of natural resins (465, 466) and waxes (467) were studied. The demand for silicone rubbers (468-471), resins (365, 472, 473), and oils has increased from 7 million lb. in 1951 to an estimated 15 million lb. in 1958 (474). Other developments in elastomeric polymers (475-479) pertained to fluorinated products (267-270), urethanes (302-304), rubber hydrochloride (480), chlorosulfonated polyethylene (481), polybutadiene (482), perdeuteropolyisoprene (483), and blends of rubber with phenolic resins (309) and polyethylenes (182, 230). New polymers were prepared from propanediol carbonates (484), phthalocyanines (485), nitroethylene (486), trans-cinnamoylferrocene (487), hydrazine (488), oxacyclobutanes (489), diallylammonium halides (490), phosphorylated compounds (491), and metallo-organic derivatives of phosphorus (492) and silicon, titanium, and aluminum (493). A noteworthy study was made of 44 terpolymer systems of vinyl monomers to determine charge ratios required to yield clear resins (494). Engineering (495) and statistical (496) aspects, control of catalyst concentration by diffusion through a molecular (plastic) sieve (497), and use of labeled initiators (498) were among the topics highlighted in reports on polymerization processes (499, 500).

Reinforced plastics: Evidence is accumulating that glass-fiber- and asbestos-reinforced plastics are competitive with refractory metals and ceramics for missile and space-vehicle structures that are exposed to ultra high temperatures for short periods (501-509). A glass-flake paper (510) and a cross-creped kraft paper (511) were among the new reinforcing materials put on the market. Glass-fiber-filled injection molding compounds (512) have provided an additional medium for further extending the many combinations and applications of reinforced plastics (513-517). Important advances in processing technology included a triple-spray gun for applying glass fibers, resin, and catalyst to a mold surface (518), continuous forming of fibrous mats (519), automatic resin content control in high-pressure laminates (520), and improved techniques for preforming (521), postforming (522), and bladder molding (523). Developments in resins for laminates dealt with epoxies (125), nylon (340), phenolic (310), and polyesters (357).

Reinforced plastic boats accounted for about 60,000 of the 400,000 small craft sold in 1957; 75,000 RP boats are envisioned for 1958 with preemption of 60 to 70% of the market within five years (524-527). Four firms are now manufacturing RP pipe; production may reach 2 million lineal ft. in 1958 and 5 million ft. in 1960 (528). Other significant applications of reinforced plastics included bus seats (529), trailer vans (530), torpedo launchers (531), transformer vault (532), television cabinets (533), radar reflectors (534), filter plates (535, 536), decorative murals (537), machine tool covers and guards (538), translucent panels (539-541), springs (166), repair of equipment (542), protective coverings (543), conveyor trays (544), and sump-pump chambers (545).

Comprehensive data were published on the effects of two shapes of china clay (kaolinite) filler (546), molding pressure (547), fiber finishes (548, 549), lay-up configuration (550), and fabrication variables (551-553) on the properties of reinforced plastics. Other important contributions were made relative to fatigue properties (554, (*To page* 142)

A Family Affair: Paul F. Prince, Sr., grandson Gary and son Paul F. Prince, Jr., put finishing touches on Kodapak Sheet greenhouse No. 2.

How good is Kodapak Sheet for greenhouse use?

"...so good we're building another!"

reports Paul F. Prince, Jr. of Prince's Farms, Springfield, N.J.

As you read this, the Princes' second greenhouse covered with Kodapak Sheet will be up and in operation. Unlike their first, it is being built, not on hope, but on two seasons' experience with Kodapak Sheet.

Here's what Mr. Prince himself says about greenhouses covered with clear, transparent Kodapak Sheet:

1. Construction costs, maintenance, and taxes are low.
2. Fuel costs are low, too—with less watering needed.
3. Since Kodapak Sheet transmits more than 90% of visible light, it helps us get to market earlier and with better plants.

It may pay you, too, to investigate versatile Kodapak Sheet—if not as a greenhouse covering, then for storm windows and doors, cold-frames, outdoor signs and many other applications where a tough, weather-resistant material is wanted.

Call our representative for information or write:

Cellulose Products Division
EASTMAN KODAK COMPANY, Rochester 4, N. Y.

Sales Offices: New York, Chicago, Atlanta. Sales Representatives: Cleveland, Philadelphia, Providence. Distributors: San Francisco, Los Angeles, Portland, Seattle (Wilson & Geo. Meyer & Co.); Toronto, Montreal (Paper Sales Ltd.)

Kodapak Sheet MAKES GOOD PRODUCTS BETTER

"Kodapak" is a trademark for Eastman's plastic sheet

555), creep (556), long-term rupture strength (557), screw-holding power (558), surface erosion (559), glass transitions (560), weathering (561), and moisture capacity (562), of reinforced plastics and biological action of glass-fiber-resin dust (563).

Foamed plastics: Use of plastics foams in the building industry will multiply fivefold in the next several years according to one manufacturer, with phenolic, styrene, and urethane types offering the greatest promise (564, 565). The advantages of these low-density core materials in supplying stiffness and insulating qualities to sandwich constructions are major factors in this growing market (566-572). The electronics industry is another important consumer of foamed plastics (573-575). The properties of cellular plastics were described in many reviews (576-580), some of which dealt specifically with urethanes (286-299). Apparatus was described for the investigation of cell structure (581).

Plasticizers, stabilizers, colorants: Plasticizer production in 1957 increased 5% over 1956 to reach 442 million lb.; about 75% of this total is used in vinyl plastics (582). Developments in new plasticizers for vinyl resins were reported (135-138, 417-419, 583-585), as well as data on electrical behavior (586), toxicity (587), and identification by chromatography and infra-red spectroscopy (588). New stabilizers against ultraviolet light were described (589). Alkylene carbonates provide highly polar solvents for polymers (590). Guides to selection of colorants were published (591). Effects of fillers in epoxy cast resins (126, 127) and glass-fiber-reinforced laminates (546) were investigated.

Processing

Sound design is recognized as basic to the economic success of molding operations and molded parts; many important contributions were added to the fund of knowledge on this phase of the industry's activities (594-601). Automation in compression (306, 602, 603) and injection (604, 605) molding and extrusion-thermoforming (606) is another facet of operations of extreme significance to management today. A critical analysis was made of the factors and problems involved in operations of captive versus custom molding plants for the production of compression and injection molded parts (607).

Many improved techniques were described for use in compression (608-611) and injection (195-199, 612-616) molding, extrusion (200, 201, 342, 423, 617-624), vacuum forming (54, 173, 201, 625-628), fabrication (51, 518-523, 629, 630) and machining (631, 632) of reinforced plastics, production (633) and heat-sealing (634-636) of films, casting operations (156, 637-641), and application of coatings to fabrics and paper (424, 642). Important developments were reported in methods and equipment for repair of molds by electroforming (643), compounding thermoplastics (644-647), metallizing (648), labeling and marking materials (649, 650), joining and fastening plastics parts (651-653), frosting acrylic sheeting (654), and fabricating acrylic enclosures (655). Slush molding (205), dry-coloring (206-208), printing (209), bonding (210-212), and heat-sealing (213, 214) were among the operations receiving attention in the rapidly growing polyethylene processing area.

Applications

Agriculture: Increased productivity at lower costs is the key to expanding uses of plastics in the agricultural industry. Polyethylene, vinyl, and polyester films are moving into such applications as mulches, silos, greenhouses, and piping (656, 657). A revolutionary approach to subsurface agricultural and construction drainage involves simple equipment that can be hooked to a tractor; it digs a trench and feeds an arch of vinyl sheeting into position at a rate as high as 1½ miles per hour (413).

Aircraft: The need for materials of improved heat-resistance for use in missile and satellite structures (658) promoted further developments in reinforced plastics and studies of their properties (308, 501-509). Other applications for plastics in this field include insulation and protection of electronic components (573, 659), styrene foam for covering bolts and rivets in fuel cells of missiles (660), and epoxies for tooling (661).

Automobiles: It is estimated that 50 to 60 lb. of plastics will be used in 1965 cars compared to the present 15 to 20 lb. (662). Over 200 buses in New York City are now fitted with reinforced plastics seats and plans call for their use on the entire fleet of 2000 buses (529). Plastic-coated metals (663) and urethane foams (295, 530) are also entering into new engineering design of cars and trailers.

Boats: In addition to the burgeoning business in reinforced plastic boats, plastics are used for outboard motor housings, marine hardware, propellers, and molds for boat construction (524-527, 664, 665).

Building: This industry consumed in 1957 about 683 million lb. of plastics (666, 667) as

POLYETHYLENE PAPER-COATING line (Ref. 617), turning out 72-in. wide material, includes the following essential parts: A) extruder barrel; B) cross-head die; C) polished chill roll.

follows: phenolics 163, other thermosets 78 (melamine, urea, epoxy, polyester, urethane), vinyls 170, styrenes 93, polyethylene 98, other thermoplastics 53 (acrylics, cellulosics, saran, etc.), miscellaneous plastics 28 (silicones, synthetic latexes, etc.). They found applications in foundations, roofs (539, 567), walls (402, 537, 540), glazing (541) thermal insulation (564, 565), sump pump chambers (545), and sealants (167, 668, 669). Air-supported coated-fabric structures continue to gain favor for warehouses, factories, and shelters (352, 403).

Chemical: Advances in engineering materials of construction (2) and in processes in the plastics industry (670) were reviewed. The manifold uses of plastics in the chemical industry encompassed water-softener tanks (231), filter plates (535, 536), expansion bellows (278), feeder worm (57), cooling towers (671, 672), processing and transport tanks (673), heat exchangers (674), diaphragm valves (675), and liners for shipping containers (676). See also Piping.

Electrical: A comprehensive review of the use of plastics in the electronics industry revealed that radio and television account for over 10% of all custom molding, that 70 million lb. of polyethylene and 89 million lb. of polyvinyl chloride were used in wire and cable insulation, and that 85 million lb. of phenolics went into electrical devices (677). Progress in plastics dielectrics (678-682) included batteries (683), printed circuits (684-686), circuit breakers (687), control knobs (688), and wire and cable insulation (689-692).

Packaging: Significant trends in plastics packages were pointed up in a survey that stressed new design concepts and new processing methods in an industry that deals in billions of units; for example, polyethylene squeeze bottles zoomed from 50 thousand units in 1951 to 400 million units in 1957 and is expected to reach 1½ billion units in 1960 (693). Innovations in packaging materials (694, 695) were highlighted by major developments in polyethylene films (219-223). Methods for skin and blister packaging (696), heat sterilization in plastics (697), and container testing (378) were described.

Piping: It is predicted that the $45 million sales volume of plastics piping in 1957 will increase to $200 million in 1963 (698). A major use of plastics pipe is in the chemical process industry to handle corrosion problems (699, 700). Developments in polyethylene (217, 218, 246, 247), polyvinyl chloride (404-406, 425), acrylonitrile-butadiene-styrene (387), and reinforced plastic (528) pipes were reported.

FLUIDIZED deposition process (Ref. 737) was used to produce reinforced PE.

Textiles: About 30% of all textiles produced in the United States are used in industrial applications and about one-third of these are fabricated from man-made fibers. The annual per capita consumption of fiber is about 36 lb.; increased production will keep pace with population growth and man-made fibers are expected to account for all or more of this increase (701). Properties and uses of synthetic fibers and fabrics (702, 703), in particular, fibers made of polytetrafluoroethylene (274) and polyethylene terephthalate (356), were reviewed.

Other applications: Plastics now account for about 5% ($100 million) of the furniture market, using 150 million lb. of resin; further advances can be expected in this tradition-bound but economy-minded industry (704). Another area in which the use of plastics is increasing rapidly is footwear; in the United States 600 million pairs of shoes are sold annually. Heels, soles, uppers, and other shoe components in 1958 used 3 million lb. of polyethylene and 4 million lb. of cellulose acetate, as well as quantities of acrylic, vinyl, nylon, butyrate, and styrene plastics (479, 705, 706). Injection-molded shell cases of ABS material (382) and torpedo launchers of reinforced plastics (531) underwent operational and cost studies by ordnance agencies; another interesting ordnance development is the use of polyethylene cartridge casings for small arms (233). Medical (707, 708) and protective clothing (709) uses of plastics were described. Industrial applications included tooling (147-150), photocopy equipment (710), mine conveyor belting (711), lubricants and bearings (712), scintillators (713), and railroad equipment (714). Uses of plastics for buttons were reviewed (715).

Adhesives: New developments were reported in adhesives based on cyanoacrylates (59), epoxies (162-165, 168, 318), phenolics (317-319), polyesters (366), neoprene (716), and hydrogenated polybutadiene (717). Selection of adhesives for special purposes was considered (718, 719), including the bonding of sandwich panels (568) and metals (720-723). Other noteworthy reports dealt with the measurement of adhesion (163, 724-727), stresses in adhesive joints (728-730), heat-resistant adhesives (318) and topography of pressure-sensitive adhesive films (731).

Coatings: Protective coatings represent a major market for synthetic resins, consuming over 800 million lb. in 1957, of which more than 50% were alkyd resins. Major developments were reported in epoxies (158, 159, 314), polyethylene (228, 229), fluorocarbons (276), urethanes (300), phenolics (314-316), silicones (732), vinyls (314, 407), and latex paints of acrylic, styrene, and vinyl acetate types (733, 734). Informative surveys of coating materials (735, 736) and methods for applying them to fabrics (642) were published. The use of fluidized air-agitated plastic powder for coatings (737) was outstand-

MASKING of acrylic part to be decorated by metallizing (Ref. 738) is accomplished in automatic machine which sprays-on masking film.

ing among the technological developments that were reported (738-742).

Properties

Numerous reviews appeared surveying the properties of plastics (240, 743-745) and methods of testing (746-748). Important contributions were made to our knowledge of tensile properties (144, 239, 749-752), impact strength (238, 241, 426, 478, 557, 578), creep behavior (81, 237, 556), fatigue testing (79, 554, 555), dynamic mechanical properties (78, 343-345, 753-757), flow (758, 759), friction characteristics (346, 760, 761), abrasion resistance (762, 763), surface erosion (559), fracture phenomena (80,476), deflection of pressurized transparent plastics (82), and screw-holding power of laminates (558). Other noteworthy studies related to thermal stability (83, 84, 427-430, 764, 765), flammability (766-768), softening points (769), thermal insulating properties (770), weathering resistance (235, 236, 561), permeation by gases (243-245, 562, 771-776), electrical properties (141-143, 242, 282, 777-780), and bactericidal (781) and toxicological (782) problems. Significant new data were obtained in investigations of photothermoelasticity (169, 783, 784), surface tension of polymers (785-787), absorption on carbon (788), and heats of wetting (789). Chromatographic (790, 791) and infra-red spectroscopic techniques predominated in analytical procedures for acrylics (90), epoxies (139, 140), polyolefins (260), polyesters (357-372), styrenes (379, 380), vinyls (451), aminoplastics (462-464), urethanes (463), and plasticizers (588).

Molecular configurational and weight characteristics of high polymers (792, 793) were studied by viscometric (794, 795), osmotic pressure (796, 797), light scattering (798-800), and ultracentrifugal (801) methods. Other investigators reported on glass transitions (802, 803), crystallinity and molecular orientation (804-808), Kerr effect (809), degradation by ultrasonic waves (810), and detection of free radicals in polymers by electron spin resonance (811-813). Solubility (814, 815) and diffusion (816-818) effects in polymer solutions were described. The mechanism of energy transfer in plastic phosphors was investigated (819).

Standards

Technical Committee 61 on Plastics of the International Standardization Organization (ISO/TC 61) met in Washington, D. C. in November and approved 6 Draft ISO Proposals and 5 new Draft ISO Recommendations, bringing the total approved Draft ISO recommendations to 29. The new draft recommendations cover standard atmospheres for conditioning and testing plastic materials, recommended practices for compression and injection molding of test specimens of thermoplastics and compression molding of test specimens of thermosetting materials, and determination of melt flow index of polyethylene and its compounds. The draft proposals relate to tensile properties, stiffness determination by the torsion pendulum method, Vicat softening point, tracking under moist conditions, viscosity of polyamide resins in solution, and acetone soluble matter in phenolic molding materials. A final revision of a Draft ISO Recommendation listing approximately 800 equivalent terms in several languages was prepared for submission to the ISO Council for approval and publication. The next meeting of ISO/TC 61 will be held in Munich, Germany in October 1959.

The year's activities in A.S.T.M. Committee D-20 on Plastics were marked by record accomplishments, including the adoption of 10 new tentative methods of test, 9 new tentative specifications, and a tentative standard for abbreviations of terms relating to plastics; also adopted were revisions of nomenclature and definitions, 5 test methods, and 5 specifications, including a major re-write of the specification for polyethylene molding and extrusion materials. The new test methods covered diffuse light transmission of reinforced plastics, Vicat softening point, Bierbaum scratch hardness, tensile modulus of elasticity of thin sheeting, dilute solution viscosity of polyethylenes, bearing load of corrugated reinforced plastics, determination of carbon black in ethylene plastics, flatness of sheet and tubing, time-to-failure of plastic pipe under long-term hydrostatic pressure, and short-term rupture strength of thermoplastic pipe, tubing, and fittings. The new specifications pertained to biaxially oriented styrene plastic sheet, random chopped glass fiber reinforcing mat, glass fabric reinforced epoxy resin laminates, non-rigid vinyl sheeting, molding and extrusion materials based on 1) methylstyrene-acrylonitrile copolymer, 2) polymethylstyrene, and 3) cellulose propionate, and dimensions of 1) iron pipe size (IPS) and 2) solvent welded (SWP size) extruded acrylonitrile-butadiene-styrene (ABS) pipe. Proposed methods of test for environmental stress cracking and surface flammability using a radiant heat energy source were prepared and published (820).

A.S.T.M. Committee D-14 on Adhesives adopted a specification for adhesives for automatic machine labeling of glass bottles and five methods of test covering hydrogen ion concentration of dry

(To page 181)

WORLD-WIDE PLASTICS DIGEST

Abstracts from the world's literature relative to plastics. For complete articles, send requests direct to publishers. List of addresses is at end of this section.

General

U. K. plastics output to soar. Chem. Eng. News 36, 90-1 (Oct. 20, 1958). It is predicted that plastics production in the United Kingdom will increase 50-fold in the next 25 years. It increased 20-fold between 1933 and 1957. The new increases will be largely in structural applications.

Nuclear radiation effects on materials. G. Reinsmith. ASTM Bul. No. 232, 37-47 (Sept. 1958). The basic principles of nuclear radiation are reviewed. The effects of nuclear radiation on materials are discussed. 43 references.

Urethanes: No return. Chem. Eng. News 36, 40-41 (Sept. 29, 1958). Although the prices of the ingredients to make urethane plastic foams have decreased and the volume increased, there has been no profit return to the manufacturers. Uses and properties of urethane plastic foams are reviewed briefly.

Materials

Additives strengthen sintered nylon. L. W. Alexander. Prod. Eng. 29, 86-87 (Sept. 15, 1958). Nylon is sintered with graphite or molybdenum disulfide additives to yield a product that has improved strength and moisture resistance. The sintering is carried out in a non-oxidizing atmosphere with the temperature being maintained just below the melting point of the nylon. In general, adding graphite lowers the rate of moisture absorption, and increases flexural strength at the expense of ductility and impact resistance. The design aspects of the sintered nylons are also discussed.

Still more polyethers. Chem. Eng. News 36, 48 (Oct. 13, 1958). Polyethers used to make urethane foam plastics are reviewed.

What's happening to linear polyethylene? D. R. Cannon. Chem. Eng. 65, 86, 88, 90 (Sept. 22, 1958). The market, both present and future, for linear polyethylene (PE) is discussed. U. S. capacity is now approximately 300 million lb. and will reach 510 million lb. by the end of 1960. The most optimistic projections for consumption are 135 million lb. this year and 400 million lb. in 1962. Thus over-capacity is expected to exist at least until 1962. The special properties of linear PE such as increased rigidity, tensile strength, etc., are not expected to disturb much of the market of conventional PE. At least one-half of linear PE's markets will be in areas now served by other plastics. Polypropylene (PP) has approximately the same advantages in terms of properties over linear PE that linear PE has over conventional PE. The price of PP is almost the same as linear PE, making it competitive. The relationships of the "composition-of-matter" patent recently issued and the two major low-pressure techniques to the market situation are also discussed.

Molding and fabricating

Magnetic-force welding. F. R. Park. Product Eng. 29, 82-85 (Sept. 15, 1958). A magnetic-force welding technique for joining vinyl-clad steel with no damage to the vinyl coating is described in detail. Prior methods of joining vinyl-clad steel were mechanical or with adhesives. The present technique uses extremely short weld times, of the order of $1\frac{1}{2}$ milliseconds and avoids any softening or blistering of the vinyl coating.

What a plastics engineer should look for when planning to buy an extrusion machine. R. E. Monica. Plastics Tech. 4, 817-30 (Sept. 1958). The points to be considered in selecting an extrusion machine are discussed. The characteristics of current extrusion equipment are presented in tabular form.

Reliable properties can be guaranteed. R. S. Jackson. Plastics Tech. 4, 831-35, 837-38 (Sept. 1958). Statistical analysis and control can be used to reduce costs, improve the product and enable the producer to guarantee properties.

Shrinkage and post-shrinkage of molding powders. H. Teipelke. Kunststoffe 48, 395-6 (Aug. 1958). The designer of a molded article should take into account both mold shrinkage and post-shrinkage. This is especially important when the article has to comply to close dimensional specifications, and the type of molding powder to be used is in fact governed by the shrinkage properties. Some experimental results obtained as a result of several years' work with many different types of molding relating to this problem are described.

Auxiliary equipment saves money for molder. M. Bloom. Canadian Plastics 1958, 38-39, 45 (Aug.). There are other prerequisites to good molding besides good molding machines, well-designed and constructed molds, and molding material that is easy to handle. The advantages of weigh feeders, hopper loaders, dryers, grinders, temperature control units, and water recovery systems are presented. Considerable monetary savings through elimination of waste and excess personnel, as well as a uniformly good product, are among the advantages of using auxiliary molding equipment.

Applications

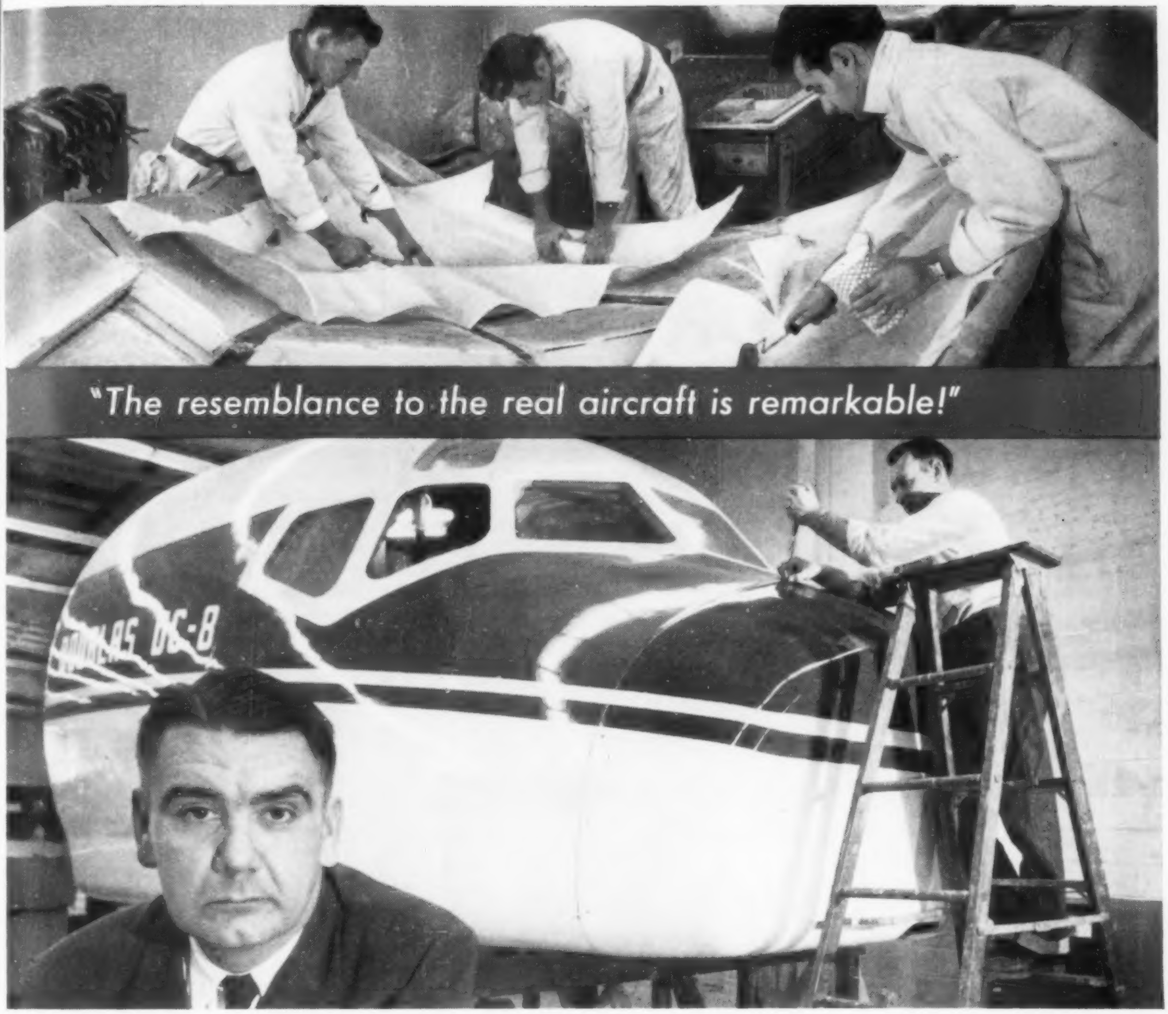
Control knobs for military electronic equipment. T. G. Nessler. Elec. Mfg. 62, 115-118 (Sept. 1958). The design, construction, and application of plastic control knobs for military electronic equipment are discussed. The titles and numbers of the specifications for such knobs are listed. The knobs must have high impact strength, be held by two sets of screws, and meet the environmental conditions specified for the equipment. The dimensions for tactile control knobs, pointer knobs, sound knobs, crank knobs, dial knobs, and transmitter knobs are given in detail in tabular form.

Plastic barges closer. Chem. Week 83, 58 (Oct. 4, 1958). Barges are made of plastic-coated nylon fabric.

Latex paints: Knocking on wood markets. Chem. Week 83, 93-4 Oct. 4, 1958). Coatings made from resin latexes are described. These include both primers and finish coats for exterior use.

Equipment can now don polyethylene coat. Chem. Eng. 65, 152, 154 (Sept. 8, 1958). A flame-spray technique permits the coating of steel surfaces with a uniform coat of

(To page 148)



New Link Simulator Cockpit For Douglas Jetliner Built Economically

with RCI POLYLITE RESIN

Realistic surroundings help train air crews for tomorrow's jet transports. It is vital that conditions encountered in actual flight be simulated closely on the ground.

Even the exterior appearance of the training model should be lifelike. And the Link Aeronautical Corporation of Endicott, N. Y., which builds the cockpit for Link Aviation, Inc. in Binghamton, N. Y., has found that reinforced plastic construction utilizing RCI POLYLITE polyester resin now makes it possible to duplicate every outside detail accurately and economically.

Mr. Felix Aimonetti, Vice President and General Manager of Link Aeronautical states: "The use of POLYLITE polyester resin as a laminating agent helps make this Douglas DC-8 training cockpit a rigid, durable, realistic structure, with a surface that resists corrosion and is easily painted. Our experience with POLYLITE resin has continued to impress us with the high quality of laminating it performs."

If you think that RCI POLYLITE polyester resin can be incorporated in one of your products and wish information about its use in laminating, molding and other reinforced plastic applications, write for free Booklet B.

REICHHOLD

Synthetic Resins • Chemical Colors • Industrial Adhesives
Phenol • Hydrochloric Acid • Formaldehyde • Glycerine
Phthalic Anhydride • Maleic Anhydride • Sebacic Acid
Ortho-Phenylphenol • Sodium Sulfite • Pentaerythritol
Pentachlorophenol • Sodium Pentachlorophenol
Sulfuric Acid • Methanol

REICHHOLD CHEMICALS, INC.,
RCI BUILDING, WHITE PLAINS, N. Y.

RCI

Creative Chemistry... Your Partner in Progress

polyethylene (PE). The flame spraying is followed by a heat treatment. Application temperatures are such that there is little danger of dimensional changes of the steel. Most commercial applications have been in the 8- to 10-mil range. The process has been tried to date only with the high-density PE.

Properties

Orientation of the crystalline and amorphous regions in polyethylene film. D. R. Holmes and R. P. Palmer. J. Polymer Sci. *31*, 345-58 (Sept. 1958). The orientation in the crystalline and amorphous regions of a series of polyethylene films prepared by the tubular film extrusion process was studied by a combination of X-ray diffraction and optical methods. All of these films show a relaxation orientation differing both from the fully relaxed type of orientation previously proposed by the authors, and from the more complicated type of orientation suggested by Keller.

Strength and toughness of high polymers as a function of temperature. W. Späth. Gummi u. Asbest *11*, 24-27 (Jan. 1958). The force necessary to rupture a specimen as determined by static tensile tests is plotted against the temperature at which the test was made to give a bell-shaped curve. Dynamic tensile tests give the same shaped curve. This supplies a better characterization of the toughness of a material than an impact test, since high impact and low deformation and low impact and high deformation give the same value on an impact tester.

Testing

Onset test for stability of uncatalyzed polymerizable resins. T. E. Bockstahler, A. P. Kotloby, E. M. Beavers, F. H. Zimmerli, and O. C. Kohler. Ind. Eng. Chem. *50*, 1581-82 (Oct. 1958). A stability test method based on differential thermal analysis technique was developed specifically for use with uncatalyzed polyester resins at elevated temperatures. A relatively simple, easily assembled apparatus automatically records the associated temperature changes accompanying a typical vinyl polymerization under controlled conditions. Polymerization is detected at a very early stage, well before significant viscosity changes are apparent. The "onset of polymerization" so revealed may be applied in the same manner as "gel time" to the prediction of stability at lower temperatures. The entire polymerization curve is character-

istic of the system under study and can be used by manufacturer and fabricator alike in the control of both new and stored resins.

Determination of maleic anhydride in polyesters. P. D. Garn and H. M. Gilroy. Anal. Chem. *30*, 1663-65 (Oct. 1958). The maleic anhydride content of polyesters is determined by hydrolyzing in chloroform (or benzene) and aqueous potassium hydroxide mixture. The aqueous layer is acidified and the maleic acid determined polarographically. The method is suitable for process control in preparation and formulation of polyesters.

Method for dielectric measurement of degree of hardening of molded phenolic resin. Th. Gast and G. Gramberg. Gummi u. Asbest *10*, 618 (1957). The method is described theoretically and data from measurements of the dielectric constants and loss factors at 100 cycles and 100 mc. in the temperature range of −50 to 60° C. for four different molded phenolics are given. Specific conductance increased exponentially in the same temperature range.

Chemistry

Polymers made easily. Chem. Eng. News *36*, 52-53 (Sept. 15, 1958). Interfacial polycondensation is used to make a wide variety of polymers quickly and easily at room temperature.

Graft polymerization. P. Piganiol. Kunststoffe *48*, 398-402 (Sept. 1958). Known information on graft polymerization is summarized, possible developments are suggested.—END

Publishers' addresses

A. S. T. M. Bulletins: American Society for Testing Materials, 1916 Race St., Philadelphia, Pa.

Analytical Chemistry: American Chemical Society, 1155 Sixteenth St., N. W., Washington 6, D. C.

Canadian Plastics: Monetary Times Printing Co., Ltd., 341 Church St., Toronto 2, Ontario, Canada.

Chemical Engineering: McGraw-Hill Digest Publishing Co., Inc., 330 W. 42nd St., New York 36, N. Y.

Chemical and Engineering News: American Chemical Society, 1155 Sixteenth St., N. W., Washington 6, D. C.

Chemical Week: McGraw-Hill Publishing Co., 330 W. 42nd St., New York 36, N. Y.

Electrical Manufacturing: The Gage Publishing Co., 1250 Sixth Ave., New York, N. Y.

Gummi und Asbest: A. W. Gentner Verlag, Forststr. 131, Postfach 688, Stuttgart 14a, Germany.

Industrial and Engineering Chemistry: American Chemical Society, 1155 Sixteenth St., N. W., Washington 6, D. C.

Journal of Polymer Science: Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y.

Kunststoffe: Karl Hanser Verlag, Leonhard-Eck-Strasse 7, Munich 27, Germany.

Plastics Technology: Bill Brothers Publishing Corp., 386 Fourth Ave., New York 16, N. Y.

Product Engineering: McGraw-Hill Publishing Co., 330 W. 42nd St., New York 36, N. Y.

U. S. PLASTICS PATENTS

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 25¢ each.

Resins. H. L. Bender, A. G. Farnham and J. W. Guyer (to Carbide and Carbon). U. S. 2,849,416, Aug. 26. Polyglycidyl ethers of phenolic resins.

Filaments. R. A. Hayes and F. A. Bozzacco (to Firestone). U. S. 2,849,-419, Aug. 26. Polyacrylate-on-vinylidene chloride resin-graft copolymer filaments.

Resins. T. D. Weldin (to Du Pont). U. S. 2,849,421, Aug. 26. Alkylated alkylol urea resins.

Polymers. V. A. Miller (to Firestone). U. S. 2,849,426, Aug. 26. Carboxyl-containing polymers.

Resin. W. N. Baxter (to Du Pont). U. S. 2,849,431, Aug. 26. Chlorination of polypropylene.

Polymerization. R. W. Kibler, F. A. Bozzacco and L. E. Forman (to Firestone). U. S. 2,849,432, Aug. 26. Polymerization of diolefins.

Reinforced plastics. F. C. Thompson (to G. F. Shea, J. A. Mullen, and J. M. Neale). U. S. 2,850,421, Sept. 2. Simultaneously spraying glass fibers and resin composition onto a forming mandrel.

Polymerization. G. Oster. U. S. 2,850,445, Sept. 2. Photopolymerization of vinyl compounds.

Cellular plastics. A. Mitchell (to Du Pont). U. S. 2,850,464, Sept. 2. Cellular polyurethanes.

Polymer. G. F. D'Alelio (to Koppers). U. S. 2,850,465-6, Sept. 2. Polymeric alkenylaryloxy-acetic acid.

Cellular plastics. M. D. Livingood (to Du Pont). U. S. 2,850,467, Sept. 2. Continuous production of cellular polyurethanes.

Interpolymers. R. M. Christenson (to Pittsburgh Plate Glass). U. S. 2,850,469, Sept. 2. Soluble interpolymers of ethylenic monomers and polyesters.

Polyurethanes. F. S. Maxey (to Goodyear). U. S. 2,850,474, Sept. 2. Curing polyurethanes with methylol melamine.

Resins. S. O. Greenlee (to S. C. Johnson). U. S. 2,850,475, Sept. 2. Polyepoxy polyesters.

Polymers. H. W. Coover, Jr. and W. C. Wooten, Jr. (to Eastman Kodak). U. S. 2,850,478, Sept. 2. Methacrylonitrile polymers.

Interpolymer. D. B. Capps (to Chemstrand). U. S. 2,850,479, Sept. 2. Acrylonitrile graft interpolymers.

Polymers. G. F. D'Alelio (to Koppers). U. S. 2,850,480-1-2, Sept. 2. Hydroxyalkyl alkenylaryl ether polymers.

Polymer. J. B. Ballentine, K. R. Lea and W. K. Easley (to Chemstrand). U. S. 2,850,483, Sept. 2. Polyethylene terephthalate.

Polymers. G. F. D'Alelio (to Koppers). U. S. 2,850,484, Sept. 2. Polymers and copolymers of N-pyrimidyl amides.

Polymers. G. F. D'Alelio (to Koppers). U. S. 2,850,485-6-7, Sept. 2. Polymeric triazol compositions.

Polymers. W. N. Baxter, I. M. Robinson and L. H. Rombach (to Du Pont). U. S. 2,850,488, Sept. 2. Hydrocarbon polymers.

Polymer. N. Turnbull (to Du Pont). U. S. 2,850,489, Sept. 2. Polyvinyl alcohol production.

Polyethylene. P. J. Canterine and A. N. DeVault (to Phillips). U. S. 2,850,490, Sept. 2. Vulcanized polyethylene.

Polymerization. M. H. Nickerson. U. S. 2,851,407, Sept. 9. Polymerization of chlorotrifluoroethylene.

Resins. J. C. Petropoulos (to American Cyanamid). U. S. 2,851,429, Sept. 9. Combination of aminoplast and alkyd resins.

Resins. J. C. Petropoulos (to American Cyanamid). U. S. 2,851,431-2, Sept. 9. Oil-modified alkyd resins.

Resins. A. K. Forsythe (to Armstrong Cork). U. S. 2,851,436, Sept. 9. Diisocyanate-modified polyesters.

Resins. J. C. Petropoulos (to American Cyanamid). U. S. 2,851,437, Sept. 9. Unsaturated polyester resins.

Resins. H. A. Clark (to Dow Corning). U. S. 2,851,439, Sept. 9. Siloxane-borate compositions.

Polymers. G. F. D'Alelio (to Koppers). U. S. 2,851,440, Sept. 9. Dihydroxyalkyl allylaryl ether polymers.

Resin. F. P. Greenspan and R. E. Light, Jr. (to Food Machinery). U. S. 2,851,441, Sept. 9. Polybutadiene polyhydric phenol resin.

Resin. C. L Michaud (to Celanese). U. S. 2,851,442, Sept. 9. Amino-aldehyde resins.

Resins. J. L. R. Williams and T. M. Laakso (to Eastman Kodak). U. S. 2,851,443, Sept. 9. Copolyesters of a glycol, terephthalic acid, and an alkylene diamine dicarboxylate.

Terpolymers. G. L. Wesp and R. J. Slocombe (to Monsanto). U. S. 2,851,444-6-7-8, Sept. 9. Clear terpolymers of styrene, methacrylic acid, and diethyl fumarate.

Ion exchange. H. S. Bloch (to Universal Oil). U. S. 2,851,445, Sept. 9. Carbonyl-exchange resins.

Copolymers. C. E. Schildknecht (to Air Reduction). U. S. 2,851,449, Sept. 9. Copolymers of trifluoroethyl vinyl ether.

Polymers. J. E. Pritchard (to Phillips). U. S. 2,851,450, Sept. 9. Solid polymers of pyridines and quinolines.

Polymerization. R. E. Foster and G. M. Whitman (to Du Pont). U. S. 2,851,451, Sept. 9. Ethylene polymerization.

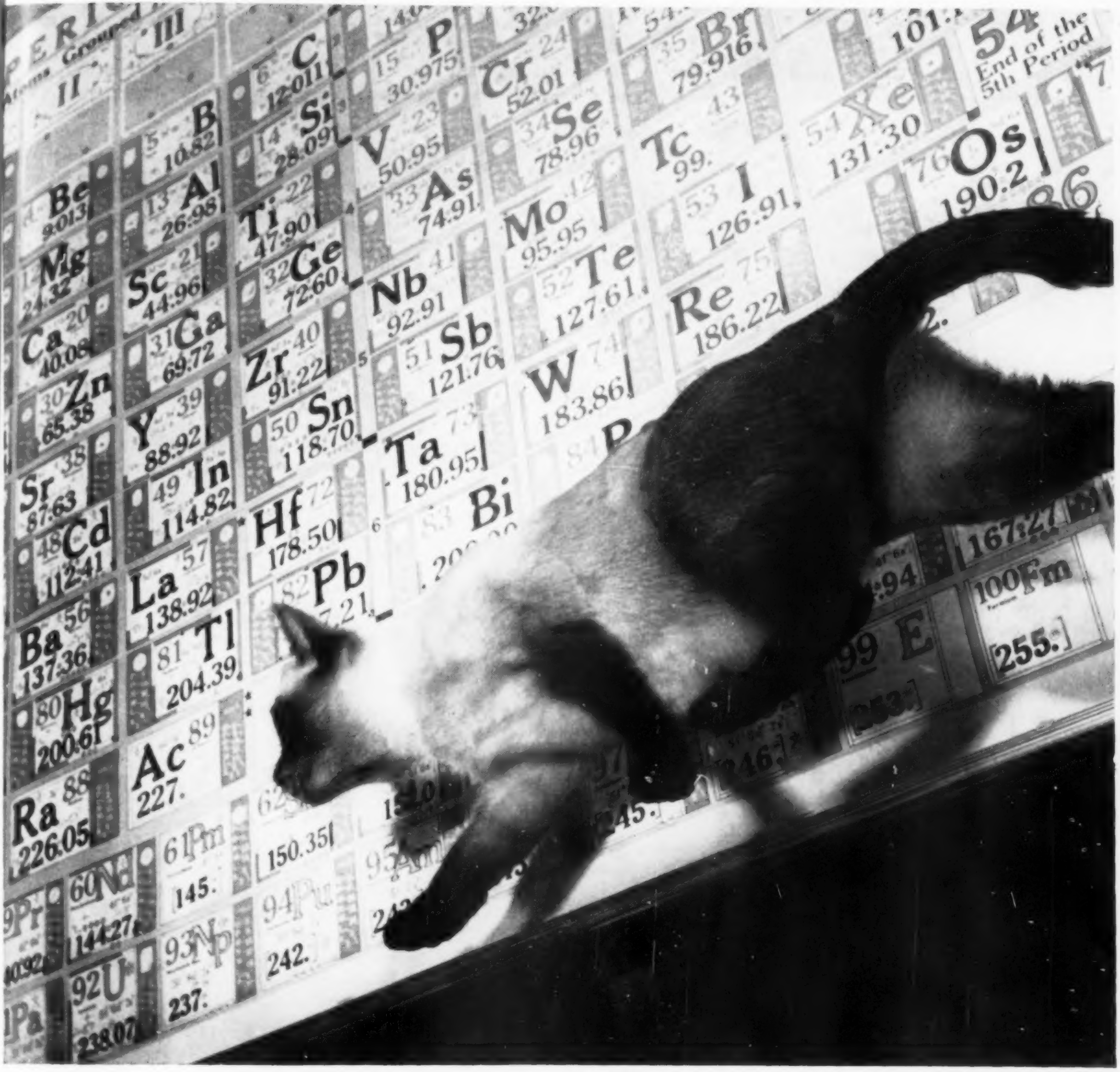
Springs. F. W. Reinhart, M. C. Slone, L. Horn, and D. A. George (to U. S.). U. S. 2,852,424, Sept. 16. Reinforced plastic springs.

Resin. R. M. Christenson, L. O. Cummings, and D. P. Hart (to Pittsburgh Plate Glass). U. S. 2,852,475-6, Sept. 16. Polyalkylene glycol modified alkyd resin-aminotriazinealdehyde resin.

Resin compositions. S. O. Greenlee (to S. C. Johnson). U. S. 2,852,477, Sept. 16. Compositions of polyamides and polyepoxide polyesters.

Plastisol. P. R. Graham (to Monsanto). U. S. 2,852,482, Sept. 16. Vinylidene polymer-dialkylphthalate-alkyl ester plastisol.

Polyurethane. W. L. Mason (to Armstrong Cork). U. S. 2,852,483, Sept. 16. Plasticizing a polyurethane-polyether composition.—END



Periodic Chart of the Atoms, Copyright W. M. Welch Mfg. Company, Chicago*

ARGUS GETS THE ANSWERS – CAT-QUICK!

You can't keep your customers waiting when something goes wrong with a vinyl formulation. That's why more and more of our customers call on Argus, where they get quick, accurate answers to their problems.

Every member of the Argus Technical Service Staff is an expert on vinyls. Technical service from Argus is equivalent to having your own vinyl research laboratory right on the spot – because we work with vinyl stabilizers and plasticizers around the clock.

This kind of no-nonsense, well-informed research has made Argus the leader in the industry – and Argus Mark stabilizers and Drapex plasticizers the industry's recognized standards.

No matter how complex your problem, ask Argus. We'll find the answers for you quickly – in our regular line products or in basic, original research done on your own formulations by our Technical Service Staff. Write today for technical bulletins and samples.

ARGUS CHEMICAL CORPORATION / New York and Cleveland

Main Office: 633 Court Street, Brooklyn 31, N. Y. Branch: Frederick Building, Cleveland 15, Ohio

's.: H. M. Royal, Inc., 4814 Loma Vista Ave., Los Angeles; Philipp Bros. Chemicals, Inc., 10 High St., Boston; H. L. Blachford, Ltd., 977 Aqueduct St., Montreal

LITERATURE

Write for these publications to the companies listed. Unless otherwise specified, they will be sent gratis to executives who request them on business stationery.

"Processing of Thermoplastic Materials" *Edited by E. C. Bernhardt.*

Published in 1959 for the S.P.E. by Reinhold Publishing Corp., 430 Park Ave., New York 22, N.Y. 690 Pages. Price: $18.00.

This book, the latest in the S.P.E.'s Plastics Engineering Series, is also the first to deal with a branch of plastics engineering at the technical, rather than the purely practical, level. For the first time, this book—by 20 leading plastics engineers—makes available in one volume most of the latest and best engineering information on all phases of thermoplastics processing.

It is divided into three main parts: a section on fundamentals underlying most polymer processing operations, the main bulk of the book that uses these fundamentals as a basis for analysis of processing, and a data section that provides information on properties of plastics important to processing. The fundamentals section has chapters on flow of melts, heat transfer and thermodynamics, and mixing and dispersing. Section II has seven chapters: extrusion, injection molding, calendering, mixing and dispersing processes, sheet forming, forming of hollow articles, and sealing and welding. Section III, whose compiler set standards worthy of serious consideration by all material suppliers, contains mostly data on flow of commercial plastics, with some data on density, and thermal properties. There is much brand new data here, and a fair amount of brand new analysis and design information elsewhere in the book.

The S.P.E. and its members can certainly be proud of this work—its level is something for future authors of other works in this series to shoot for.—*J.F.C.*

"International Plastics Directory"

Published in 1958 by Verlag fuer Internationale Wirtschaftsliteratur G.m.b.H., P.O.B. 108, Zurich 47, Switzerland. 1056 pages. Price $18.00

More than 10,000 companies in 69 countries are listed in this directory. One section is devoted to producers of plastics raw materials, a second section provides detailed information on convertors and fabricators, including number and types of machines, trademarks, etc. Both sections are separated into countries, and company listings are in alphabetical order by city; there is no listing by end product. Trade associations, schools, research laboratories, literature services, periodicals, are listed in separate sections. A cross-referenced company index is also included.

A very comprehensive dictionary of German, English and French terms used in the plastics industry is also provided.

Glass Textiles for Industry. Shows how glass filament is woven into glass fabrics for the plastics and 25 other industries. Includes types, applications, glass tape specifications, weaving processes, finishes, decorative fabrics, etc. 32 pages. *Hess, Goldsmith & Co., Inc., 1400 Broadway, New York 18, N. Y.*

Production facilities. Products, services, and facilities of this firm, including available sizes, grades, thicknesses, and finishes of Insurok, a proprietary family of laminated plastics; and typical custom molded products. Catalog 20.000.13. 12 pages. *The Richardson Co., 2731 Lake St., Melrose Park, Ill.*

Conveyor belts. Construction, specifications, splicing, and engineering data for a new line of Koroseal conveyor belts in plastics and other plants where belting comes in contact with cutting oils, greases, wet and sticky materials, and where smooth, non-porous, non-marking belts are needed. Data Sheet 2470. 2 pages. *B. F. Goodrich Industrial Products Co., 500 S. Main St., Akron 18, Ohio.*

Teflon impregnated tapes and laminates. Chemical, physical, and electrical properties; sizes; tolerances; and other technical data for a line of glass-base Teflon sheets, tapes, laminates, Di-clads, and fabricated parts. Bulletin GST-58A. 8 pages. *Continental-Diamond Fibre Corp., Newark, Del.*

Essential oils; aromatic chemicals. Prices, descriptions, market information, etc., for a line of essential oils, aromatic chemicals, and certified colors, including aldehydes, balsams, gums, geraniol and esters, oleoresins, etc. 36 pages. *Dodge & Olcott, Inc., 180 Varick St., New York 14, N. Y.*

Polymeric plasticizers. Physical properties; uses; test data; accelerated aging, resistance to extraction, and exudation data, etc., for two new polymeric plasticizers: Elastex 36-R Plasticizer, a medium-molecular-weight material for nitrile elastomers and vinyl. Technical Data Report C-5827. 2 pages. Elastex 37-R Plasticizer, a high-molecular-weight material for vinyl compounding. Technical Data Report C-5828. 2 pages. *Plastics & Coal Chemicals Div., Allied Chemical Corp., 40 Rector St., New York 6, N. Y.*

Hydrous alumina silicates. Chemical and physical properties, particle size distribution analysis, uses, etc., for hydrous alumina silicates, a filler material used in the plastics and other industries. Bulletin 1257. 8 pages. *Summit Mining Corp., Carlisle, Pa.*

Vinyl coated fabrics. Swatches, colors, applications, etc., for vinyl-coated fabric materials for wall-coverings and upholstery. *Canadian Resins and Chemicals, Ltd., 600 Dorchester St. W., Montreal 2, Quebec, Canada.*

Filaments. Properties, typical processing conditions, creep rate, weather resistance, coloring and stabilization, ultra-violet stabilization, applications, and other information for high-density polyethylene filaments. 6 pages. *Phillips Chemical Co., Bartlesville, Okla.*

Laboratory facilities. "Quality Control—A Company's Conscience at Work" describes test procedures and facilities to assure high standards of quality for the company's butyrate, propionate, acetate, and polyethylene resins. 20 pages. *Eastman Chemical Products, Inc., Kingsport, Tenn.*

Catalysts. Revised edition of "Physical and Thermodynamic Properties of Elements and Compounds" includes enthalpies and heat capacities of many common elements and compounds, equilibrium constants for several common (*To page 154*)

reactions, and information for computing equilibrium constants for other reactions, values of many constants, conversion factors, steam tables, and the periodic table. New in this edition are equilibrium constant data for propadiene, methyl acetylene, cyclohexane, and carbonyl sulfide. 40 pages. *Chemical Products Div., Chemetron Corp., P. O. Box 337, Louisville 1, Ky.*

Rigid plastic containers. Sizes, capacities, colors, etc., for a line of printed and unprinted polystyrene and high-density polyethylene containers for packaging, including threaded, shoulder, shell, and beaded types. 4 pages. *Lermer Plastics, Inc., 502 South Ave., Garwood, N. J.*

Chemicals catalog. Composition, properties, and applications for a line of chemicals, including sections devoted to organic intermediates, acetylene derivatives, carbonyl iron powders, ethylene oxide, and glycols, as well as optical brighteners, ultraviolet light absorbers, etc. 64 pages. *Antara Chemicals, 435 Hudson St., New York 14, N. Y.*

PVC compounds. "Colour Range No. 1A for Geon Flexible PVC Compounds" show samples and characteristics of the 13 colors available. Technical Folder G123. 4 pages. *British Geon, Ltd., Devonshire House, Piccadilly, London W.1, England.*

Chemical Resistance of Plastics. Compatibility of 51 plastics with 82 corrosive media, is given in 4-color reference chart. Plastics are classified according to chemical composition, current scientific name, and some current tradenames. A longer list of tradenames is included elsewhere in the booklet. In English. 34 pages. *Corrosion Dept., Central Laboratory, Staatsmijnen in Limburg, P. O. Box 18, Geleen, The Netherlands.*

Dimethyl ethers. Physical and chemical properties; specifications; suggested uses; toxicity; shipping requirements, etc., for a line of dimethyl ethers; E-121 (ethylene glycol); E-141 (diethylene glycol); E-161 (triethylene glycol); and E-181 (tetraethylene glycol); which are used as solvents for cellulosics and other materials 44-item bibliography. 24 pages. *Ansul Chemical Co., Marinette, Wis.*

Production facilities. "Custom Molders of the Unusual" shows the variety of custom molded parts, jewelry, decorative products, etc.,

produced. 8 pages. *Standard Plastics Co., Inc., 62 Water St., Attleboro, Mass.*

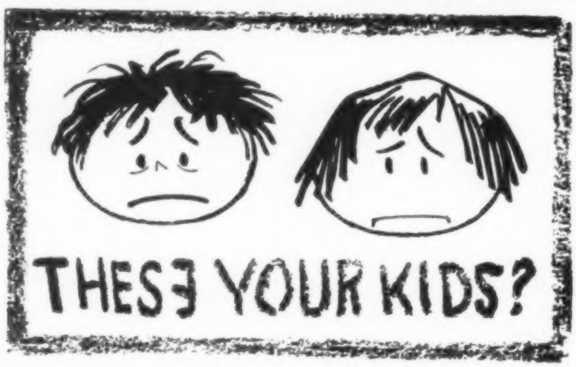
Vinyl. "Geon Rigid Vinyl for Extruded Components" gives physical properties, chemical immersion data, applications, design advantages, etc., for Geon 8700-A and 8750, two unplasticized compounds. 12 pages. "Good-rite Plasticizers Insure High Quality Vinyl Plastics" shows specifications and performance data, storage and testing procedures, etc., for a family of eight plasticizers. 18 pages. "Solution Resins" summarizes properties, preparation of solutions, compounding, applications, etc., for a line of Geon solution resins. 18 pages. "Vinyl Resins for Rigid Applications" lists physical and chemical properties, applications, mixing conditions, comparisons, etc., of Geon Resins 404HI and 103EP, two vinyl chloride resins. 10 pages. "Latices" tells the compounding, viscosity, effect of loading on physical properties, applications, handling and storage, etc., for Geon latices, which are colloidal dispersions of vinyl chloride polymers and copolymers in water for coating, impregnating, saturating, etc. 22 pages. *B. F. Goodrich Chemical Co., 3135 Euclid Ave., Cleveland 15, Ohio.*

Epoxy resin laminate. Properties, applications, etc., for Grade EP-22, a paper-base, epoxy resin laminate designed for printed circuits and other electronic applications. Bulletin EP-22. 2 pages. *Synthane Corp., Oaks, Pa.*

Plastic hoops. "Hoop-De-Do . . . Ideas and Innovations" shows how the recent fad can be extended through modification of hoops with a variety of new toys and games—lariat, roller, drum, jump rope, water games, lawn shower, etc. 12 pages. *Phillips Chemical Co., Bartlesville, Okla.*

Reinforced plastic moldings. "Fiberglass Reinforced Plastic Moldings for the Product Designer" discusses material and properties, advantages, methods, design considerations, research and development facilities, etc. *Winner Mfg. Co., Inc., P. O. Box 399, Trenton 3, N. J.*

Injection molding materials. Properties, chemical resistance, aging, machining, cementing, applications, etc., for Bextrene polystyrene and Bexoid cellulose acetate molding powders. Technical data sheets also available. 10 pages. *BX Plastics, Ltd., Higham Station Ave., London E.4, England.*—END



U.S. PLASTICS

Production and sales figures in 1000 lb
for August and September 19

Materials	Total p'd'n first 9 mos. of 1958‡	Total sales first 9 mos. of 1958‡
Cellulose plastics:[a]		
Cellulose acetate and mixed ester:		
Sheet, under 0.003 gage	12,844	12,542
Sheet, 0.003 gage and over	13,553	12,897
All other sheets, rods, tubes (including other cellulose plastics)	6,699	5,852
Molding, extrusion materials (including other cellulose plastics)	63,830	62,145
Nitrocellulose sheets, rods, tubes	2,279	2,438
Other cellulose plastics	3,056[g]	2,209[g]
Phenolic and other tar-acid resins:		
Molding materials[a]	112,506	112,469
Bonding and adhesive resins for:		
Laminating (except plywood)	46,207	30,820
Coated and bonded abrasives	8,906	7,858
Friction materials (brake linings, clutch facings, etc.)	8,897	8,564
Thermal insulation	34,869	34,874
Plywood	37,548	31,570
All other bonding uses	27,078	27,103
Protective coating resins	20,693	18,038
Resins for all other uses	22,062	17,453
Urea and melamine resins:		
Textile-treating resins	24,002	23,461
Paper-treating resins	19,463	17,182
Bonding and adhesive resins for:		
Plywood	69,444	69,710
All other bonding and adhesive uses, including laminating	31,119	28,176
Protective-coating resins	22,075	17,889
Resins for all other uses, including molding	65,246	63,252
Styrene Resins:		
Molding materials[a]	303,538	321,383
Protective-coating resins	68,396	66,569
Resins for all other uses	114,047	91,375
Vinyl resins, total[b]	564,761	563,071
Polyvinyl chloride and copolymer resins (50% or more polyvinyl chloride) for:		
Film (resin content)		53,332
Sheeting (resin content)		46,034
Molding and extrusion (resin content)		148,595
Textile and paper treating and coating (resin content)		43,800
Flooring (resin content)		82,248
Protective coatings (resin content)		22,263
All other uses (resin content)		43,911
All other vinyl resins for:		
Adhesives (resin content)		35,383
All other uses (resin content)		87,510
Coumarone-indene and petroleum polymer resins	174,276	173,979
Polyester resins:		
For reinforced plastics	72,203	66,340
For all other uses	9,138	8,669
Polyethylene resins total:	623,639	592,415
For film		223,516
For all other uses		368,818
Miscellaneous:		
Molding materials[a,d]	30,446	31,173
Protective-coating resins[e]	12,170	6,151
Resins for all other uses[f]	105,160	92,479

*Dry basis designated unless otherwise specified.
†Revised.
‡Partially estimated.
[a]Includes fillers, plasticizers and extenders. [b]Production statistics by uses are not representative, as end use may not be known at the time of manufacture. Therefore, only statistics on total production are given. [c]Includes data for spreader and calendering-type resins.

PRODUCTION

From statistics compiled by the U. S. Tariff Commission

August†		September‡	
Production	Sales	Production	Sales
1,346	1,215	1,295	1,428
1,400	1,450	1,716	1,820
803	692	936	771
8,734	8,095	8,215	8,067
229	232	223	206
[g]	[g]	[g]	[g]
11,129	13,836	15,341	15,388
6,006	4,260	6,615	4,638
978	1,056	1,061	991
942	1,203	1,337	1,321
4,236	4,400	4,376	4,327
4,956	4,166	5,041	4,401
3,312	3,222	3,162	3,307
2,868	2,143	2,557	2,207
2,711	2,287	2,966	2,584
2,705	3,122	2,981	2,846
2,687	2,402	2,349	2,221
8,845	8,566	10,404	9,918
3,880	3,558	4,355	3,783
2,420	2,342	3,197	2,658
7,011	7,111	8,212	7,796
33,946	34,379	40,361	41,122
7,242	7,289	8,290	8,034
13,253	10,641	14,896	12,052
†69,672	†71,659	82,133	75,493
	6,594		6,696
	5,547		6,688
	19,286		20,313
	6,245		6,194
	10,530		10,340
	2,810		2,370
	†6,789		7,236
	4,362		4,308
	9,497		11,349
22,545	23,180	20,492	20,226
6,905	6,778	7,337	7,144
†1,086	†1,076	1,394	1,422
68,064	70,046	75,252	85,158
	23,352		25,421
	46,694		59,736
4,123	4,246	4,229	4,561
1,845	743	2,117	705
†11,697	†10,789	11,587	10,959

[d]Includes data for acrylic, nylon, and other molding materials. [e]Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins. [f]Includes data for acrylic rosin modifications, nylon silicone, and other plastics and resins for miscellaneous uses. [g]This classification discontinued in May and this material, mostly ethyl cellulose, reported in sheets and molding material.

Vinyl chloride

(From pp. 78-83)

luggage, and, in good volume, for wiring devices on electric irons and other appliances.

Slush molding or rotational casting is growing nicely. Dolls, toys, hobby horses, and play balls probably consume over 20 million lb. a year. Rigid plastisols, which got a good start in 1957, continued on the upgrade in 1958. But they have not yet gained their niche in industrial housings such as air ducts, or various other types of hollow shapes, where they are expected to become large volume even though blow molded polyethylene is expected to cut into this market. Other possible uses for molded or cast plastisols, especially the rigid type with air used as a "filler," are toilet seats and wastebaskets. Conventional, well established uses for molded plastisols also include air filters, sewer pipe gaskets, and yard ornaments. Molded plastisol arm rests for autos are back again. However, these frequently use other materials such as urethane, with the plastisol serving as a protective skin. Rainboots are still a good outlet for plastisols, even though about half the market is now general-purpose vinyl.

Extruded profiles dropped down in 1958—the villain again was the automotive industry where so much is used for welting around doors. Extruded water stops inserted between concrete slabs in dams and other structures constitute a big potential use; but the application hasn't yet reached a million lb. volume in the U. S. The Canadians used a reported million lb. for such stops in constructing the St. Lawrence Seaway.

A new development during the year was an extruded foam windlacing with a Mylar surface laminate which is being used around the doors of hard top convertibles. This same extruded sponge may enter the market as weather stripping. When produced by casting on a steel belt this vinyl sponge may compete with urethane for inner-lining in clothing.

The amount of unplasticized vinyl copolymer resin used for

phonograph records in 1958 is thought to have been about the same as in 1957. Some phonograph record makers are now using extenders in what were once solid vinyl formulations and thus require less resin. Polystyrene continues to move into the field, with one company using only styrene for its 45s; but most of the larger records are in vinyl.

Vinyl garden hose is a good example of "what shouldn't be done" in plastics. A few years ago some 15 million lb. of virgin vinyl was used for this application—the decline to 7 million or less resulted from cut prices and consequent use of low-grade materials, including plasticizers. Such hose became stiff and often failed. Customers often switched back to rubber. But there is still a fair amount of nylon-reinforced and also transparent hose on the market that uses first-grade resin.

Extruded unplasticized or rigid vinyl pipe, tubing, and shapes made progress in 1958 and their prospects look good. Pipe has taken hold particularly well in Florida where it is used in air conditioning systems and utility company water lines where metal pipe is subject to salt water corrosion. Processing plants in which corrosion from salt, chlorine, and other chemicals are problems find it helpful in easing maintenance problems. In the western United States it is used in oil fields, particularly where brine or paraffin is encountered. In Japan it is reportedly in bigger volume use than steel pipe; but it is less costly than the metal in that country.

Extruded shapes account for 2 or 3 million lb. of the total 11 million lb. (see Table on p. 82) used in this country. Building contractors are slow to adopt new materials without a long testing period, but window frames are already on the way and at least one wooden window frame maker is using vinyl tracks in his construction. It is also applicable in tracks for book cases. Vinyl has several advantages over aluminum for window frames including color and non-conduction of cold air.

Unplasticized extruded film and sheet is included in "Sheeting 10 mils and over" in the table on p. 80 but is currently small. A new die which permits extrusion of a 52-in.-wide sheet of thicknesses up to 1/8 in. should give impetus to the extrusion process for making sheet. Thick sections of vinyl sheeting ordinarily have had to be built up by laminating thin sections of calendered sheeting in the past.

There is some indication that an extruded, low-cost unplasticized copolymer thin film may soon be available in quantity in this country. It will compete in the specialty packaging market for textile and paper goods wrapping where its clarity and resistance to moisture are outstanding; an additional feature is the fact that it can be printed in distortion and in perfect registration. The trick for successful extrusion is said to be a streamlined die that will prevent dead spots which result in irregularities. But like any other film, unplasticized film will require special machinery to handle it before it becomes a large scale packaging medium.

Floor covering resins had a banner year in 1958. All kinds of vinyl flooring were on the upgrade but the rigid type used with vinyl-asbestos is now the leader. A new laminate type with reverse printing on the top layer, mentioned earlier, and with marbleized effect is particularly popular. The printed paper type, protected with a layer of transparent vinyl plastisol and bonded to a felt base gained great headway. The original producer now has competition from several other manufacturers. There was never a better measure for success than to have competitors start producing a similar line. The replacement market for vinyl flooring has recently become exceptionally strong and accounts for a large part of its extraordinary growth. But there is still lots of room for more growth—a 150 million lb. consumption of resin in this field would not be surprising in two or three years. Nevertheless, the industry is heedful of a saturation point that will be reached within the next four to eight years when continued rapid growth can no longer be expected.

Resin used for fabric and paper coating and treatment was under 1957 volume, primarily because of

a decline in the upholstery market. There may be overlapping in this figure as shown in the Table on p. 80, and some of the resin may be reported under "miscellaneous" rather than under "fabric or paper treatment." Vinyl latex belongs in there somewhere. Large quantities are used for priming fabric before it is coated and other quantities are used for coating paper board that is used in auto door paneling before the final film or sheet is applied. Vinyl latices or plastisols are also widely used as a binder in sanitary napkins and unwoven fabric.

Related uses of vinyl include its application to paper or unwoven fabric for wall coverings, where growth has been disappointing. However, some improvement is expected, although the market is not as big as it seems even if vinyl had the major portion. Resin used for treatment of paper in certain types of floor covering is no longer reported in this classification—it is now in floor coverings where it belongs. Conventional uses for vinyl formulations on paper in big volume are cap liners, shelf paper, and coatings for paper containers such as those used for ice cream and throw-away cups.

Spread-coating of plastisols on fabric for upholstery suffered a drop of 15% or more in the first half of 1958 but made a fairly good comeback in the latter half.

Although film and sheeting are listed separately in the Tariff Commission Report, it is generally conceded that the separation is inaccurate because of faulty reporting to the government by individual producers. However, the total of the two is a reasonably accurate statistic.

A point to remember when comparing '58 and '57 is that the monthly film figures for 1958 are not comparable with 1957 because of a sizable error in 1957 plus the fact that several companies were not reporting at that time. When these errors are adjusted it is believed that film volume in 1958 was about the same as 1957. Sheeting was down in 1958 because of the general economic decline in durable goods plus a loss of part of its market to film for laminating purposes. Film came back faster during the last half

of 1958 because a big inventory in finished goods that had been built up previously was liquidated faster than expected and film producers introduced large quantities of new designs and patterns to meet the fall demand.

The resin used for film includes an estimated 6 or 7 million lb. used for extruded and cast film, neither of which has shown any appreciable gain in recent years.

The sheeting total includes an estimated 18 million lb. of calendered, unplasticized vinyl copolymer sheeting. This material used for thermoformed signs, packaging, ducts, housings, and lighting fixtures has been growing steadily for five or six years. As mentioned before, straight, unplasticized, extruded PVC may soon move into this field in quantity lots; and a straight PVC homopolymer, which was claimed to process as easily as the copolymer, was introduced last year.

The Table on p. 81 is intended primarily to show trends for uses of vinyl film since 1953. The figures are intended to give only a general idea of how much material is used. No reliable system has yet been developed for accurate reporting to a neutral agency. The influence of imported resin that is converted into film is not known, but it is probably less in 1958 than other years because several large volume film producers who once used it are now making their own resin.

The table provides an interesting history on the permanent decline in some items and regular growth in others. Most noticeable decline is in draperies which were all the rage in the late 1940's. The market gave way to other materials, except in bathroom and kitchen curtains which are as big or bigger than ever. Embossed thin polyethylene film took over part of the long drapery market.

Yard goods consumption has declined steadily, but part of the reason is a prevalence of thinner gage material in this market. Some marketers think the reason for a decline is that women sew less than formerly, but the sewing machine manufacturers are selling more machines than ever.

Laminations are surprisingly down in 1958, although this is a

field where more growth is expected. A thinner film frequently used for laminating is one reason why poundage is down. Laminated tarpaulins have been slow in catching on because of the necessity to use a 3-mil film, which raises costs. Laminates for upholstery made good progress, but upholstery demand was down.

Inflatables had another good year in 1958. The 7.5 million lb. reported here is only part of the market—there is more in sheeting. Much of the inflatable stock is made up of laminates of 2-, 3-, and 4-mil film.

There was a major shift in the fabricating end of the rainwear business that resulted in greatly increased business for some and losses for others, but the overall result seems to have been a substantial increase. A mail order house reports an exceptionally good season in rainwear. Sportswear such as golf jackets, fishermen's jackets, and parkas are in good demand.

Shower curtains continue to consume large quantities of resin. The first six months of 1958 were excellent, but there was a lag in the last quarter. Possibly the new three-dimensional lenticular design which was so popular in 1957 has run its course and the industry is now waiting for another spectacular.

The year 1958 may be described as that period when the vinyl chloride industry slowed down to catch its breath and survey its accomplishments. It is now known that many vinyl end products have reached their peak—the age of maturity for them has arrived. With that happening have come problems of profit making and an examination of other markets where the industry can expand. Companies that wish to be on a profitable basis in the future cannot be followers—they will have to dig for new resins and new ideas. The possibilities are vast, but they aren't likely to be found in such things as draperies or garden hose or other saturated markets. The time has come for the vinyl chloride industry to drop its hook in some new fishing grounds and to find more attractive bait in many of the waters where it is now fishing.—END

Polyethylene

(*From pp. 73-78*)

expected to expand for years to come, but rigid bottles made from linear polyethylene are expected to double or triple the use of polyethylene in bottles within the next five years.

Pipe declined in 1958 because of a poor year in the all-over pipe industry. But there were also signs that quality was on the downgrade resulting from the use of large amounts of off-grade and reprocessed material. A pipe customer can buy first-grade material if he pays a little more; but he seems to expect to buy first-grade for the same price as second-grade —and then squawks if it fails in use.

A notable development in pipe resins was the announcement of Allied's extremely high-molecular-weight high-density resin which can be extruded into pipe without resultant creep or stress cracking. This is an extremely unusual development because resins of such high m.w. are extremely difficult to extrude or mold and those of lower m.w. are often subject to creep or stress crack. Pipe with an O.D. of 10 in. is now extruded from this material and a 20 in. pipe is reportedly on the way.

Use of polyethylene for coating paper, foil, and film is only in its infancy, but one of these days it is going to assume the stature of a Goliath. There are no accurate statistics showing separation of the various types of coatings represented by the figure of 35 million lb. in 1957, but here is one producer's estimate: Paper coating accounted for 16 million lb.; film, foil, and wax used in wrappers accounted for about 7 million each. The 1958 estimate is not yet available but paper coating increased slightly because of the increase in coating of paper board. Film and foil coating may have increased by 10% each and polyethylene used in wax could have gone up to 10 million.

Expected growth in polyethylene coating over other materials such as paper or film may reach a total of perhaps 100 million lb. in the next three to five years—some analysts expect even more. The recently publicized fear that a shortage of wax for paper coating may develop is scorned by polyethylene producers who believe that PE will move into the field in ever-increasing quantity. This view is buttressed by a belief that such products as frozen foods, cereal, milk, and butter will eventually be packaged in PE-coated containers.

The future for polyethylene points to a market for 2 billion lb. of conventional polyethylene and 1 billion lb. of linear polyethylene within the foreseeable future, according to one company's prognostications. Those are tremendous potentials, but polyethylene is a tremendous material. This growth won't come overnight and there will be a long, competitive struggle that will be costly to some entrepreneurs and profitable to others, but until something better comes along polyethylene is destined to become the backbone of the plastics industry.—END

Polystyrene

(From pp. 83-86)

packaging products, window frames in jet planes, and bowling balls. Among its proudest applications is an injection molded bathroom scale that won a citation in the recent Bachner award competition.

Acrylonitrile-styrene material has had some hard luck in applications where it was the first choice but later lost out to lower-cost material. Hair curlers, where its resistance to chemicals was thought unchallengeable, were lost to paper. Specialty items of this sort come and go as users experiment with other materials. Some copolymer items frequently lose out to impact styrene because of cost. But where chemical resistance is important, as in a cap on a deodorant bottle or in some types of storage batteries, it is generally accepted. Clarity too is an important property, especially for tumblers, which is probably the single leading item from a volume standpoint.

Another new copolymer was added to the list when Dow announced development of a styrene-methacrylate molding material suggested as a replacement for methacrylate molding material in those applications where lower cost is more important than weathering properties.

When all the impact and copolymer materials are subtracted from the total volume of molding material used, the general-purpose material consumed in 1958 would be something over 200 million lb.—perhaps 220. One company states that impact and copolymer uses together are at least 55% of all the styrene molding and extrusion material consumed.

The percentages given in the chart on p. 84 indicate how all styrene type molding materials are used. When listing various classifications there is considerable overlapping; and companies vary in their methods of classification. A standard system and a neutral agency to which each company could report its output without fear of disclosure would be welcomed by some of the producers in order to give an accurate industry-wide summation of

the principal products involved, but so far there has been no move in that direction.

As shown in the chart, refrigeration and packaging uses are running about the same. Both are expected to grow. Packaging may grow a bit faster since it is picking up new applications every year. But there is always a chance that refrigeration, especially air-conditioning equipment, will pick up more poundage per unit despite the report that its use has decreased in some of the refrigerators now on the market. Total amount used in 1958 is thought to be somewhere in the 60- to 70-million-lb. range of which around 85% is estimated to be impact material. The growth in air conditioning is expected to come both from an increase in the number of units produced and increased volume of resin per unit.

The packaging increase is due to more widely accepted use of polystyrene for containers and lids, many vacuum formed. Thin oriented film is moving rapidly into this field because it remains tough over a long period of time. A new thin polystyrene film for bags was also introduced in 1958. It has already found good acceptance for such items as ladies' stockings and paper goods, such as packages of gift cards and Christmas seals, where its sparkling clarity, crispness and its adaptability as a good printing surface are desirable properties. Producers are hopeful of a future market of from 70 to 90 million lb. of polystyrene film in from five to 10 years including its use as a surface laminate. Thick oriented sheet is potentially the strongest contender in such applications as cheese box lids now in use and which may be the forerunner for various types of vacuum formed heavy-gage boxes or containers.

Polystyrene foam in packaging is also making progress not only for ornamental purposes but for effective cushioning of delicate instruments, glass bottles, and other fragile materials. A good-sized potential for foam would be in containers for ice cream and hot or cold drinks similar to the "Thermokup" now used on airplanes for coffee and which won

(To page 169)

Plasticizer Data

TO HELP YOU CHOOSE THE RIGHT PLASTICIZER

these Harflex® Plasticizers are efficient

Dibenzyl Sebacate

Permanence • Flexibility over wide temperature range • Low volatility • Good electrical properties

Appearance	Clear Liquid or White Solid
Color, APHA	100 max.
Odor	Mild
Specific Gravity 30/20°C.	1.055±0.003
Free Acidity, as Acetic Acid	0.10% max.
Ester Content	99.0% min.

Major uses:

A plasticizer in polyvinyl resins and copolymers, polyvinyl butyral and butadiene—acrylonitrile rubbers.

Dimethyl Sebacate

Extreme efficiency • Excellent low temperature properties

Appearance	Clear Liquid or White Solid
Color, APHA	100 max.
Odor	Neutral
Specific Gravity 30/20°C.	0.986±0.003
Free Acidity, as Acetic Acid	0.02 max.
Ester Content	99.0% min.

Major uses:

A plasticizer in vinyl resins, synthetic rubbers, cellulose nitrate, cellulose acetobutyrate, acrylic resins; as a chemical intermediate, and a neutral, concentrated source of the sebacyl radical.

HARCHEM produces a full line of phthalate, adipate, sebacate and polymeric plasticizers in addition to the plasticizers shown.

The Harchem Division laboratories will gladly assist you with your plasticizer problems, or will supply additional data including formulation test results and formulation suggestions for any Harflex Plasticizer.

Address inquiries to Dept. H-40.60

SEBACATES
PHTHALATES
ADIPATES

THE KEY TO HARCHEM® BETTER PLASTICS

HARCHEM DIVISION

WALLACE & TIERNAN, INC.
25 MAIN STREET, BELLEVILLE 9, NEW JERSEY
IN CANADA: W. C. HARDESTY CO. OF CANADA, LTD., TORONTO

1. SELECT the items you want
2. CIRCLE the corresponding numbers on the post card
3. FILL IN the information requested
4. MAIL — no postage required

HELPFUL LITERATURE FREE

There is valuable data — worth dollars and cents to you — in the literature and samples described below.

EQUIPMENT · SUPPLIES · SERVICES

ANTI-CORROSION COATINGS. 4-page illustrated brochure describes chemical corrosion-resistant, abrasion-proof PVC coating for machine parts, ducts, materials handling equipment, etc. Accompanying catalog sheets describe a similar PVC plastisol for spray applications; corrosion-proof sheets of plasticized PVC, etc. Quelcor, Inc. **(A-901)**

PHYSICAL PROPERTIES TESTER. 6-page illustrated folder describes an hydraulic, 47-lb., bench-type instrument for testing the physical properties of materials. Instrument releases power-driven testing machines for use where more detailed data is required. Truck Scale & Research Corp. **(A-902)**

INTENSIVE MIXER. 12-page illustrated brochure describes line of mix-mullers for uniform, intimate mixing and dispersion of plasticizers, pigments, etc., either dry or liquid. Capacities range up to 60 cu. ft. National Engineering Co. **(A-903)**

GLASS-FILLED STYRENE. Bulletin gives physical properties of three different grades of glass-reinforced styrene injection molding compounds. Fiberfil, Inc. **(A-904)**

COMPRESSION PRESSES AND PLASTICS MILLS. Series of illustrated brochures describe lines of hydraulic presses for compression or transfer molding, laminating and polishing; also lines of plastics mills, including heavy duty crackers, washers and refiners. Erie Engine & Manufacturing Co. **(A-905)**

URETHANE FOAM MIXER-DISPENSER. 12-page instruction manual describes a push-button-controlled machine that meters, mixes and dispenses up to 20 lbs. of this company's urethane resin-and-catalyst formulations per min. Nopco Chemical Co. **(A-906)**

CHEMICALS FOR PLASTICS. 8-page catalog lists this distributor's chemicals and the nationwide system of warehouses from which they are available. McKesson & Robbins, Inc. **(A-907)**

RAPID MOISTURE TESTER. 6-page illustrated brochure describes a semi-automatic machine that determines the moisture content of organic and inorganic materials in two steps instead of the conventional five-step method. C. W. Brabender Instruments, Inc. **(A-908)**

PLASTIC PREHEATERS. Series of catalog sheets describe a line of plastic preheaters that heat up to 10 lbs. of nylon, ureas, phenolics, melamines, graphite or mica-filled materials, in one minute. W. T. La Rose & Assoc., Inc. **(A-909)**

METALLIC DECORATIVE PLASTICS. Illustrated folders describe this company's metallized cellulose acetate, polystyrene, butyrate and Mylar for decorating appliances, furniture, auto interiors, radio and television sets, vending machines, etc. Coating Products, Inc. **(A-910)**

GRANULATORS, PELLETIZERS, DICERS. 20-page illustrated brochure describes this company's lines of granulators, pelletizers and dicers for reclaiming plastics. Brochure also tells how to select the right machine for the desired purpose. Cumberland Engineering Co., Inc. **(A-911)**

PLASTICS CONVEYOR. 4-page illustrated brochure describes a machine that conveys plastic particles of all sizes and shapes in smooth, sanitary, self-cleaning, one-piece metal troughs. Carrier Conveyor Corp. **(A-912)**

TAKE-OFF UNIT. 4-page illustrated booklet describes a take-off unit for extruders that operates with four heavy neoprene rolls at medium speeds of from 15 to 235 surface feet per min. Machine handles soft vinyl and polyethylene as well as rigid vinyl and Cycolac. H & P Machine Works. **(A-913)**

URETHANE FOAM PRODUCTION SYSTEMS. Illustrated 8-page brochure describes how this company guides the selection of equipment, the installation, and the pilot operation of entire production systems for plants desiring to manufacture urethane foam. Jennings Engineering Co. **(A-914)**

PREFORMERS AND HYDRAULIC PRESSES. Illustrated 16-page brochure describes this company's preformers, available in capacities ranging from 30 to 125 tons; also its self-contained, semi-automatic compression and transfer presses ranging from 10- to 300-ton capacities. Logan Hydraulics, Inc. **(A-915)**

VERTICAL INJECTION MOLDING MACHINE. 4-page illustrated booklet describes this company's 1- and 2-oz. vertical injection molding machines featuring a sliding table to facilitate loading, automatic cycling, automatic ejection and metered feed. Progressive Tool & Die Co. **(A-916)**

EPOXY CURING AGENTS. Technical bulletin describes two new co-reactants that cure epoxy resins at room temperature. The results are new polymers useful for coatings, casting, potting, adhesives and laminates. Chemical Div., General Mills. **(A-917)**

COLORS AND PIGMENTS. Handbook lists properties, applications and prices for lines of colors and pigments used in the manufacture of paints, enamels, plastics, etc. C. K. Williams & Co., Inc. **(A-918)**

ABRASION-RESISTANT FABRIC. 6-page illustrated brochure describes a fabric impregnated with a solvent-activated plastic. This waterproof, non-corrosive material has been used for automobile body repair, shoes, artificial limbs, small-craft hulls, etc. Wasco Products, Inc., Div. of Wasco Chemical Co., Inc. **(A-919)**

INJECTION MACHINE. 4-page illustrated brochure describes a four-oz. injection press with one hundred lbs. styrene plasticizing capacity per hour, and a speed of 840 dry cycles per hour. The Van Dorn Iron Works Co. **(A-920)**

VINYL RESINS & COMPOUNDS. Illustrated 4-page brochure describes this company's new copolymers, paste resins, U.L. approved resins and cold blend resins. Lists specific viscosities, applications and advantages. Diamond Alkali Co. **(A-921)**

COLORED INKS. Series of bulletins describe this company's quick-drying, non-smudge, waterproof and indelible inks for marking plastics, cellophane, highly glazed surfaces, metallic labels, etc. Acromark Co. **(A-922)**

Fill out and mail this card now

MODERN PLASTICS
MANUFACTURERS' LITERATURE SERVICE

Please send me the free items circled below. ☐ **I am a non-subscriber***
I am ☐ **a subscriber**

A-901	A-902	A-903	A-904	A-905	A-906	A-907	A-908	A-909	A-910	A-911
A-912	A-913	A-914	A-915	A-916	A-917	A-918	A-919	A-920	A-921	A-922
A-923	A-924	A-925	A-926	A-927	A-928	A-929	A-930	A-931	A-932	A-933
A-934	A-935	A-936	A-937	A-938	A-939	A-940	A-941	A-942	A-943	A-944

*If you do not have a personal subscription and would like to receive the next twelve monthly issues plus the next annual Encyclopedia Issue (U.S.A. & Canada, $7.00; all others, $25.00) please check below.
☐ Check enclosed ☐ Send bill

NAME .... POSITION ....
(Please Print Plainly)

COMPANY ....

STREET .... CITY .... STATE ......

(This card cannot be honored after April 1, 1959)

FREE HELPFUL LITERATURE

There is valuable data — worth dollars and cents to you — in the literature and samples described below.

1. **SELECT** the items you want
2. **CIRCLE** the corresponding numbers on the post card
3. **FILL IN** the information requested
4. **MAIL** — no postage required

EQUIPMENT · SUPPLIES · SERVICES

LOW-PRESSURE TANKS. Illustrated technical bulletin describes features of a line of electrically-heated, low-pressure tanks for spraying, pressure or vacuum impregnating, and conveying melted compounds to distant points. Sta-Warm Electric Co. **(A-923)**

ELECTRIC HEATERS. Illustrated booklet presents 25 case studies describing the uses and advantages of "Chromalox" strip, ring, tubular and cartridge and heating elements in plastics processing. Edwin L. Wiegand Co. **(A-924)**

MOLDING EQUIPMENT. Engineering data sheet file contains features, specifications and prices of a line of aerosol mold-release and anti-rust agents; a line of super-heaters for Reed-Prentice machines; and ball- and pineapple-type mixing and terminal plasticizing nozzles. Injection Molders Supply Co. **(A-925)**

HYDRAULIC VALVES. Illustrated data sheet folder describes line of direct-and reverse-acting, 0 to 3,000-lb. control valves with V-ported seats for water (hot or cold), oil, steam, air and gas. Includes valve capacity charts for steam, liquids and gases. Sinclair-Collins Valve Co. **(A-926)**

CAST ACRYLIC SHEETS. 4-page leaflet describes the properties of a new precision-cast acrylic sheet with close thickness tolerances and high optical clarity for windshields, signs, domes, cake box covers, etc. Cast Optics Corp. **(A-927)**

AUTOMATIC CONVEYORS. 4-page illustrated brochure describes lines of self-supporting conveyors, large-capacity standard and telescoping tube conveyors, proportional conveyors and bulk handling conveyors for all plastic materials. Whitlock Associates, Inc. **(A-928)**

EPOXY-HARDENER DISPENSER. Technical data sheet describes a dispenser that meters and delivers desired quantities of epoxy resins and hardeners for application in fiber glass fabricating operations. Unit eliminates hand-measuring of resins and hardeners. Auto-Air Industries, Inc. **(A-929)**

ELECTROFORMED MOLD CAVITIES. Technical data sheet describes this company's services for the manufacture of nickel-surfaced mold cavities. Cavities so treated are immune to rust, oxidation and effects of molding lubricants. Camin Laboratories, Inc. **(A-930)**

CIRCULAR SAW BLADES. Data sheets describe available fine pitch carbide-tipped and super-finished Radialloy-tipped saw blades for use with printed circuitry, PVC, high pressure laminates, ureas, acrylics, etc. Radial Cutter Mfg. Corp. **(A-931)**

NYLON RESINS. Technical sheet file folder describes the properties of, and application methods for, this company's line of nylon resins. Uses include protective coatings and bondings; also injection molded, extruded and compression molded products. Belding-Corticelli Ind. **(A-932)**

PLASTIC MATERIALS. 4-page folder describes this company's tinsels, metallics, phosphorescents and satin pearl effects; also its available cellulose acetate, polystyrene and polyethylene compounds. Plastics Materials, Inc. **(A-933)**

TESTING EQUIPMENT. Series of technical bulletins describe a machine for determining particle size distribution, a rotation viscometer, and alternate-stress testing machine, a hardening time meter, and a machine for determining the stability of semi-elastic plastics under pressure. Brinkmann Instruments, Inc. **(A-934)**

BLOW MOLDING MACHINES. 4-page illustrated brochure describes a line of Danish-made blow molding machines for the manufacture of bottles, doll parts, toys, etc., from thermoplastic materials. The Blow-O-Matic Corp. **(A-935)**

HEAT SEALERS AND HEATERS. 4-page illustrated brochure gives features and specifications of this company's dielectric heat sealers, industrial heating generators, portable high-frequency sealers, electronic quilters, etc. Dynatherm Div., Guild Electronics, Inc. **(A-936)**

VACUUM FORMING MACHINES. Series of data sheets describe this company's line of vacuum forming machines for continuous production of thin-gage plastic articles, skin packaging and roll feed, production of props and scenery, laboratory testing, etc. Auto-Vac Co., Div. of National Tool Co. **(A-937)**

PASTE COLORS FOR POLYESTERS, EPOXIES. Booklets containing color samples give properties, use procedures and prices on this company's lines of color pastes for epoxy and polyester resins. Plastics Color Co. **(A-938)**

DIE-CUTTING PRESS. Technical bulletin describes this company's line of heat-assist, air-hydraulic die-cutting presses for sheet plastic, skin package cards. Cutting areas range up to 30 by 50 inches. Tronomatic Machine Mfg. Corp. **(A-939)**

PLASTICIZERS. 17-page technical bulletin describes the properties, specifications and performance features of this company's line of plasticizers for vinyls. B. F. Goodrich Chemical Co., Div. The B. F. Goodrich Co. **(A-940)**

PLASTICS SAWS. Illustrated brochures describe lines of carbide-tipped saws for cutting acetates, butyrates, phenolics, polystyrene, methyl methacrylate, and urea and vinyl resins. Atkins Saw Div., Borg-Warner Corp. **(A-941)**

CUSTOM MOLDING. Illustrated 4-page brochure describes this company's services and facilities for custom molding and finishing parts from thermosetting plastics. Kurz-Kasch Co. **(A-942)**

PEARL ESSENCE FINISHES. 12-page booklet discusses the properties, application methods and features of this company's natural pearl essence and synthetic pearl pigment in the decoration of jewelry, pins, buttons, baby goods, toys, appliances, etc. Argenta Products Co. **(A-943)**

ALLOYS FOR MOLD-MAKING. Technical file folder describes a line of bismuth alloys used in making molds for plastic patterns, testing plastics, forming sheet or tubular plastics by vacuum air pressure, etc. Cerro De Pasco Sales Corp. **(A-944)**

Fill out and mail this card now

Postage Will be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD

First Class Permit 2656, New York, N. Y.

MODERN PLASTICS

Village Station Box No. 103

NEW YORK 14, N. Y.

honorable mention in the Bachner Award Competition (see pp. 96-98 of this issue). Its insulation and low cost possibilities are most desirable properties.

Wall tile stopped growing some years ago—in fact it has declined since 1955 despite new designs and patterns. Cut-throat competition and introduction of a low-cost ceramic tile have put a damper on what was once a market that was expected to grow to 60 or 70 million lb. a year.

Resin consumption for toys is shrouded in uncertainty. Some estimators put it as high as 60 million pounds. It is here that a good portion of the off-grade material sold to reprocessors for compounding enters the market. There are thousands of pounds molded into extremely low-cost toys for which there seems to be a great demand. Apparently the public has been educated to expect this kind of a product. It is not sold as a quality item and could well be listed as a short-life or throw-away product. On the other hand, the bulk of the polystyrene toy business is still a quality proposition. Polystyrene model planes, trains, and expensive toys where top notch design, thick sections, and other improved techniques are involved make it as satisfactory as any material adaptable to the toy field. Polyethylene is supposed to have moved into the low-cost toy field in sizable quantities, but so far at least it hasn't crowded out polystyrene, although it may have prevented a larger growth. Apparently the entire toy field is enlarging rapidly enough to absorb both, along with the conventional materials such as metal and wood that have always been used for toys.

Phonograph record producers are secretive about their output, but it is thought that from 7 to 9 million lb. of polystyrene were used in 1957 and 1958. There is a difference of opinion about how much of the vinyl record market will be eventually taken over by polystyrene, with various producers making different claims. Most of the polystyrene used is now going into 45-r.p.m. records and the small sizes used for children's records and commercial transcrip-

tions. One pound of resin will produce about 15 of the 45-type record, 20 of the kiddie type record, and 4 of the 33-type record.

Polystyrene use for housewares has maintained a fairly steady volume since 1956 when polyethylene moved in to prevent a continued growth. Many analysts have been surprised to see polystyrene maintain its position in this field, but price plus some clever designing have kept it well entrenched and it will probably stay that way for years to come.

Exports continue to increase, which is another surprise since polystyrene plants are now fairly well distributed over the rest of the world. However, there are not as many polystyrene as there are vinyl and polyethylene facilities; and it may be that this export market will remain fairly stable. Its low cost makes polystyrene a particularly desirable material in many countries where personal incomes are much lower than in the U. S. These countries are also a good market for off-grade material.

The high percentage of resin listed as "miscellaneous" in the chart of p. 84 might seem difficult to account for until the reader scans the partial list of items that are accounted for in this category in the Table on p. 83. There is scarcely an item in this list that consumes as much as 10 million lb. a year, but when all are added together the sum could be over 130 million pounds.

Some of the major items in this list (with their estimated consumption of resin) are: industrial lighting at over 5 million lb.; toiletries, 8 million; monofilaments, around 7 in 1958, up from 5 or 6 in 1957; novelties and premiums with 5 or 6 of first grade material and much more of off-grade; toilet seats, 3 million; one estimator says radio cabinets consumed 5 million, another says 15 million—most of which is general-purpose resin except that used in transistor types. And there are the tiny items such as clothes pins which may require ½ million lb. a year and the lowly stirrers or swizzle-sticks for liquor consumers which use 300 or 400 thousand lb. a year—and much of it first grade resin.—END

Cellulosics

(From pp. 86-89)

not yet apparent. A similar situation prevailed just before the shoe heel market developed two years ago. The pipe market looked promising for butyrate a few years ago but has declined rather than moved forward, probably because of lower cost competitors. But it has one particular advantage—clarity. When a customer wants transparent pipe he turns to butyrate.

The advent of propionate a few years ago, which is a cellulosic with extra good stability and fine surface properties, helped to broaden the cellulosic line; but it is a 62¢/lb. material (like butyrate) and is used for specialties. It has moved into the telephone hand set field, pens and pencils, appliance housings such as a new colorful cabinet for portable radios with superior surface finish that has just made its debut, and is now being tested for automotive uses such as steering wheels.

Butyrate, which accounts for more than half of the molding material volume in cellulosics, moved upward this year in outdoor applications such as signs, tail lights, numbers for use on phone poles and houses, and in that conventional old application, fence post insulators. The producer also asserts that there is still a sizable amount of butyrate in dolls.

Nitrocellulose declined considerably in 1957 and 1958 but is holding its own in spectacle frames and other specialty items. One good item doesn't show up in this report—that is the sheet material used for the Fairchild printing plate. Nor is the nitrate lacquer used for coatings accounted for in this chart; it is used not only in paint and for coating paper board used on check books, etc., but is still dominant as a coating material used on fabric for window shades.

Ethyl cellulose has been dropped from special listing under "other cellulosics" and volume is buried under miscellaneous plastics which is carried in another section of the Tariff Commission's report.—END

Nylon

(From pp. 90-91)

Nylon is likely to continue in automotive applications because it has better impact strength and abrasion resistance. Heat resistance of the two materials is about the same although one nylon formulation has a heat resistance of 250° F. In most cases nylon is self-extinguishing, but Delrin burns like most other thermoplastics.

Nylon plastics consumption in 1958, including bristles, was somewhat under 1957. The durable goods industry depression which began in September 1957 affected molded nylon parts because so many of them go into autos and appliances. On the other hand, nylon bristles, a consumer goods item, increased in 1958.

Consumption of nylon reached a record height in October 1958. The upturn began in August and was induced by a spurt in the appliance industry, led by washing machines. Total consumption for molded items and bristles is thought to have been between 20 and 25 million lb. in 1958. A 10% increase is anticipated in 1959 and a steady growth at that rate is expected for some years to come, primarily in consumer items such as marine hardware, skates, brush backs, etc.

Growth items in nylon were principally in products that had been introduced a year or two earlier. Among them were garden hose couplings—where nylon replaced brass—and a brand-new hose nozzle; drapery slides showed a big increase in 1958. Roller skates—both rollers and frame—are now made in child and adult sizes and around 100,000 pairs were made in 1958; but the market is there for many more—11 million pairs of roller skates are produced annually in the U. S. Football helmets, including the face guard, were also well established in 1958. The manufacturer claims that nylon gives the particular "resilience toughness" which he requires in a helmet. Washing machine valves, a fairly old application, are expected to increase in volume since a new hydrolysis-resistant formulation has been developed that will resist cracking. Bottles made from ny-

lon are expected to be fairly prevalent by 1960.

Efforts to channel more nylon into jacketing for wire are always under way. One place it is growing is in conduit wire where the nylon jacket helps it "slip" through. Control cable that is jacketed with nylon and that has inner wires coated with heat-stabilized nylon is becoming common.

Automotive use is increasing in volume but is still under a lb. per car. The 1959 Cadillac represents what is thought to be the first automotive use in this country of nylon film extruded from Zytel 42, a specialty extrusion grade resin. The film is used as a pouch to hold Freon as part of the shock absorber system. The same car also uses extruded tubing in its air suspension system. The 1959 Chrysler swivel seats ride on eight small nylon bushings. G. M. cars with power seats use nylon as the cable cover because it dampens sound. Ford has added window rollers to its nylon applications. Extruded tubing is used on several automobiles this year for vacuum spark line.

The first automotive use for nylon molding powder was the dome light, which was followed by door-lock rollers, and then the gears in speedometers. Other common uses are in the various small bushings and bearings.

One estimator thinks that nylon plastics (exclusive of bristles) may reach a volume of 45 million lb. in 1963, with greatest growth to come in extrusion. The latter would be 12 to 15 million lb., molding would be 26 to 30, and the balance would be special processed material such as slabs, centrifugal casting, or continuous rod. He expects 2 or 3 million of the extrusion material to be film which will find markets because of its resistance to wide temperature ranges, resistance to grease or oil, great strength as well as clarity.

It might find markets for packaging such items as motor oils and greases, lubricated bearings, lard, butter, coffee, vacuum packaged tea, processed meat and also as a coating or combination on or with cellophane and polyethylene.—END

Phenolics

(From pp. 91-94)

Another action along this line is the announcement that ICI of England would discontinue production of phenolic molding material, and concentrate on thermoplastics.

The Table on p. 93 is an indication of how the use of molding powder is distributed among the various end products. The last column with a forecast for 1963 is perhaps the most interesting since it shows how the industry expects to fare in the future.

By far the largest outlet for phenolic parts is electrical goods such as panel boards, circuit breakers, wiring devices, etc. This business does not benefit to any great extent from the growth of the electronics industry or from the trend toward miniaturization. It must depend for expansion upon the increase in power facilities and consumption of more kilowatts. Wire devices are suffering from competition from other plastics such as molded vinyl used with appliance and extension cords.

In the closures market, phenolics are meeting stiff competition from urea, aluminum, and thermoplastics and may even decline below the 12 million lb. listed for 1958.

Telephones may increase phenolic consumption in 1959 but this is expected to decline later. Colored thermoplastics have become very popular—were even advertised as Christmas gifts. Even the black ones are now frequently molded in thermoplastic.

Washing machine agitators are also expected to decline as a market for phenolics. The new drum type washers nearly all use some agitation equipment but the agitators are smaller and thinner.

Phenolic camera parts, which until recently had shown good growth possibilities are being superseded by thermoplastics units—many cases are now in styrene. The same situation applies to many other types of housings.

On the other hand appliance handles, knobs, etc., are expected to increase phenolic usage since the material gives the heat resistance and stability required. Auto-

motive use is increasing mainly because molded phenolic parts are larger in size.

From the above summary it can be seen that phenolic will hold its own in those applications where heat resistance, dimensional stability, and good electrical properties are essential. A promotional and engineering design campaign to emphasize its low cost per cubic inch when compared with other materials might encourage its use in new, large-scale applications and start an upward surge; but nothing of that sort has been publicized in the last year. Present indications are that the total amount of material consumed in 1959 will be 180 million lb., and about 185 million in 1960.

Laminating resins were down in 1958 because of the general decline in the nation's economy; but that portion of laminates that went into the decorative section of the industry increased over 1957. It may have accounted for 55% of the resin used in the laminating business.

Industrial laminates have been at a standstill for several years with not many new markets opening up and some of the old ones declining. A technical survey would be required to learn what has been happening in this field since World War II. A bright new application came into the field several years ago when printed circuits made their debut but they require only a small amount of resin per unit. About 6 or 7 million lb. of resin are estimated as used for this purpose in 1958 and that amount of resin will account for enough base material to mount millions of printed circuits.

A promising development is the use of laminates in missiles—some of them are said to require as much as 500 to 800 lb. per unit. The valuable part of this application for civilian use is that it has stimulated a vast amount of research that includes experimentation with a variety of fillers and resin formulations. Many of the formulations are copolymers of phenolic and other resins—even thermoplastics. Sometimes they are simply mechanical mixtures. Primarily the technicians are seeking greater heat resistance. But an intense study as that in

progress now often results in the discovery of materials with considerable value for general or specialty uses. Several years are frequently required before any discovery of this sort becomes of any great commercial value, but it wouldn't be surprising to see at least one resin come out of this research that will have large scale commercial possibilities.

Abrasive resins are down because the metal-working business was down about 35 or 40% in 1958. Coated abrasives were not so severely hurt, but there was very little resin used in grinding wheels since so few were sold.

Resin used in friction materials (brake linings) was under its 1957 rate, but replacement in old automobiles helped hold it up.

Thermal insulation is dependent on the construction industry and consequently remained about the same in 1958 as in 1957. It was reduced in price again by 2½¢ in liquid form and is one of the less profitable phenolic resins. On a solid resin basis it sells for 23 or 24.2¢ depending on whether it is filtered or unfiltered. One of the largest users built his own plant in 1958 and thus added to the capacity of an already overcrowded production picture.

Resin for plywood was up because the fir plywood mills had their best year since 1955. The figure of 48.5 million lb. refers of course to solid resin content but is probably low. Some of the mills who make their own are probably not reporting to the Tariff Commission.

The figure in the Table on p. 92 for "all other bonding" resins is impossible to evaluate from current information. Producers think it should be higher, but that some of the resin used for bonding is probably reported in miscellaneous. This classification includes resin for many purposes such as battery separators (15 to 16 million lb.), resistors, incandescent light bases, composition board, filters, and shell molding.

Shell molding has come nowhere near meeting its expected volume. It was perhaps 15 to 16 million lb. in 1957 and 12 or 13 in 1958. These figures also include the 1 or 2 million lb. of resin used for bonding solid cores, where ¾

to 1% resin is used as the binder. There are now several types of resin used for shell molding with a tendency to favor the sand coating type. It has various advantages over the sand-mix type in that it gives more uniformity and requires less resin although it is a bit higher in cost. The coating resins are now furnished in varnish form but a water-borne type is under way.

The foundry industry was slow in 1958 and there were few plants that switched over to shell molding from the old conventional technique. Chrysler Corp. surprised the industry by establishing a shell-molding line after indicating that they would always stick to their forging method, but like the other auto companies, their business was down. Ford and General Motors continue to add new shell-molding lines in their foundries. A threatening gesture that may prevent shell molding from ever moving to its predicted 50 or 60 million lb. volume is the development of an aluminum block which die casts very easily —if it works out successfully there will be less need for the shell molding technique as applied to other metals.

Another use for bonding resins that continues to show possibility of growth is its use as a binder with waste wood. Molded-in-shape items such as chair seats, croquet balls, toilet seats, children's ten-pins, are some of the products involved. At least 6 million lb. of resin is used for toilet seats alone. However, phenolic is only one of several resins used for these purposes.

There is also a phenolic liquid used in hardboard production for application in furniture, housings, interior panels, and even ship lap. Paper companies are building plants to produce it as it fits in with their wood waste problem and some of their machinery can be used in its production. One estimate is that 8 million lb. of phenolic resin was used for hardboard production in 1958. A small amount of resin will go a long way in this application but the final product is marketable on such a large scale that great quantities of resin may be involved.—END

Urea and melamine

(From pp. 94-95)

sidered to be a good prospect for alpha-cellulose-filled melamine because it has good moisture resistance and, since it can be molded in white, has more sales appeal than phenolic, which is now being used for this application. A melamine agitator would cost about $1 more than a phenolic unit at the factory level.

Toilet seats made from urea are slowly finding a wider use in hotels and industrial installations, but the growth of this market will depend on more manufacturers entering the field. Although urea may have better resistance to cleaning materials, it has to compete with styrene which is 30 to 40% cheaper in this application.

Wood-filled urea is now being produced commercially, and it is priced competitively with phenolics (adjusted on a specific gravity basis). However, it is too early to forecast what impact this molding material will have on the markets now served by other resins.

The textile industry provided broader uses for urea and melamine this year. For the first time, white cotton for men's dress shirts, bed sheets, etc., was included among the fabrics being treated with these resins to provide wrinkle-resistant finishes, shrinkage control, and an improved hand. Ethylene-urea-formaldehyde, which sells for around 25¢/lb. is most widely used for cotton finishing, but triazone resin—a type of cyclic urea, made in part from amine—which sells at a slightly lower price, also finds wide use for wrinkle-resistant finishes; and when the slight odor problem of this resin has been overcome, it may compete even more vigorously in the textile finishing field. Modified melamine resins, selling for as much as 50¢/lb. on a solids basis, also continued to find wide use for treating cotton, synthetics, and blended fabrics. These three types of resins now have an improved chlorine resistance and they stand up considerably better to commercial laundering.

Sales volume in 1958 was slightly lower than in 1957; prices

of ethylene-urea-formaldehyde were reduced early in the year, contributing a general profit squeeze. However, 1959 sales for these textile applications are expected to run about 5% higher than the 1958 volume.

Paper treating continues to be a promising market for urea and melamine. The materials permit development of new markets for paper, such as work clothes and other former textile applications. During the first half of 1958, production in the paper industry was below last year's, but wet-strength uses—which consume urea and melamine resins in appreciable quantities—were 10% higher than in the previous year. One explanation for this departure from the general pattern may be the paper industry's willingness to experiment with resin-treating in order to develop new markets to combat reduced sales of established lines.

Filter papers in the automotive field, air and liquid filters, and separators for dry cell batteries provide good markets for urea and melamine; and phenolics apparently did not compete as strongly for these applications as was generally thought.

The increased use of synthetic latices for paper-treating has also helped the sale of melamine resins, since the material is generally incorporated in these water- and grease-proofing processes.

The use of melamine and urea resins in the paper industry is not confined to wet-strength and water- and grease-proofing operations; they also go into hundreds of grades of highly specialized papers for industrial uses.

Urea adhesives, always subject to vicious price cutting, seem to have reached a rock bottom price at 8½¢/lb. for 65% solids. Several major suppliers have withdrawn from this market, and the remaining manufacturers probably feel that the current price structure is very close to being unprofitable for them.

Straight urea, 65% solids, is generally used as a liquid resin for water-resistant plywood mainly for interior applications, whereas spray-dried melamine-urea resins are finding increasing use in

waterproof particle board and plywood for both interior and exterior applications. Sales of urea adhesives depend to a large extent on the growth of the plywood industry, which faces very strong competition from Japanese imports.

Particular attention should be called to the ever-increasing use of urea adhesives or bonding resins similar to the type used for plywood in the production of particle board. There are now 60 mills producing particle board and although only 4 to 8% resin is used the total amount is estimated as consuming more than 30 million lb. of liquid urea. Particle board is used mostly as a core material for furniture and panels.

Spray-dried melamine-formaldehyde resin sales for decorative and industrial laminates are thought to be slightly higher than the 20 million lb. sold in 1957. In addition to the growing market for well-established applications such as table and counter tops, display cases, etc., these laminates are now being aggressively merchandized for vertical surface applications such as walls in airports, restaurants, etc., which have a very much larger volume and could result in spectacular increases in sales for these resins, which currently cost approximately 38¢ per pound.

The protective coatings sales for 1958 reflect the decline in automotive production. While melamine-alkyd finishes generally still retain their share of this market, some General Motors lines now use methacrylates to provide a long-lasting automotive finish with high gloss. But since Ford prefers melamine-alkyds, there is no indication that the trend in the automotive industry is towards methacrylate lacquers.

Eventually—some people think sometime between 1960 and 1962—a water-dispersed system of a resin formulation that is as yet unknown, will dominate the automotive lacquer market, and the industry believes that melamine might well play an important part in this change from the present solvent-dispersed system, and thus continue to be a factor in the protective coatings field.—END

1958 in review

(From pp. 135-144)

adhesive films, water absorptiveness of paper labels, bonding permanency of water- or solvent-soluble liquid adhesives for labeling glass bottles, and 1) non-volatile content and 2) filler content of phenol, resorcinol, and melamine adhesives (821).

A.S.T.M. Committee D-11 on Rubber and Rubber-like Materials prepared specifications and methods of test for flexible foams made from polymers or copolymers of vinyl chloride and methods of test for flexible urethane foam (822).

A guide to government and other national standards and specifications for plastics and rubbers provides a useful listing of these documents (823).

References

1. "Quick survey of new resins," by J. H. Dubois, Modern Plastics 36, 103-104, 205, 206, 208, 210 (Dec. 1958).
2. "Plastics," by R. B. Seymour, Ind. Eng. Chem. 50, 1470-1478 (Sept. 1958).
3. "Polymers made easily," Chem. Eng. News 36, 52-53 (Sept. 15, 1958).
4. "Polymethylene via ethylene," Chem. Eng. News 36, 46 (Apr. 28, 1958).
5. "Soluble catalyst helps properties," Chem. Eng. News 36, 56 (July 21, 1958).
6. "Graft and block polymerization," C. G. Overberger and A. Katchman, Chem. Eng. News 36, 80-85 (Nov. 10, 1958).
7. "Graft copolymers," by N. G. Gaylord, SPE J. 13, 43-43. 80 (Dec. 1957).
8 "Block copolymers," by N. G. Gaylord, SPE J. 14, 31-38 (Jan. 1958).
9. "Graft polymers—a new technology?", by D. J. Metz, Nucleonics 16, 73-77 (Apr. 1958).
10. "Graft polymerization with cationic catalysts," Chem. and Ind. 1958, 954 (July 26).
11. "Graft copolymers," by S. H. Pinner and V. Wycherley, Plastics (London) 22, 456-458 (Nov.); 503-506 (Dec. 1957); 23, 27-30 (Jan. 1958).
12. "A study of graft polymers. I. Preparation and viscosity behavior," by J. A. Manson and L. H. Cragg, Canadian J. Chem. 36, 858-868 (May 1958).
13. "Solution and fractionation properties of graft polymers," by R. W. Kilb and A. M. Bueche, J. Polymer Sci. 28, 285-294 (Mar. 1958).
14. "Graft copolymers: Synthesis and characterization," by V. E. Shashoua and K. E. Van Holde, J. Polymer Sci. 28, 395-411 (Mar. 1958).
15. "Grafting cures polymer ills," Chem. Eng. News 36, 51-52 (Aug. 11, 1958).
16. "General characteristics of the grafting reaction of preirradiated polyethylene," by A. Chapiro, J. Polymer Sci. 19, 321-342 (June 1958).
17. "Graft polymerization on polyethylene," by H. G. Hammon, SPE J. 14, 40-42 (Mar. 1958).
18. "Graft polymerization in rubber latex by gamma-irradiation," by E. G. Cockbain, R. D. Pendle, and D. T. Turner, Chem. and Ind. 1958, 759-760 (June 21).
19. "Graft interpolymers formed by gamma-irradiation of methyl methacrylate-natural rubber mixtures," by D. J. Angier and D. T. Turner, J. Polymer Sci. 28, 265-274 (Mar. 1958).
20. "Block and graft polymers. I. Graft polymers from acrylamide and acrylonitrile," by M. L. Miller, Canadian J. Chem. 36, 303-308; "II. Block polymers from acrylamide and acrylonitrile and acrylamide and acrylic acid," by M. L. Miller, ibid. 309-314 (Feb. 1958).
21. "Formation of block polymers of butyl acrylate with styrene and vinyl pyridine," by B. L. Funt and E. Collins, J. Polymer Sci. 28, 359-364 (Mar. 1958).
22. "Molecular templates do the trick," Chem. Eng. News 36, 47 (Apr. 28, 1958).
23. "Chemical and physical changes in gamma-irradiated plastics," by R. Harrington and R. Giberson, Modern Plastics 36, 199, 200, 202, 204, 206, 208-210, 212, 214, 217, 220-221, 314, 317 (Nov. 1958).
24. "Oxygen effects in the radiation chemistry of polyethylene," by L. E. St. Pierre and H. A. Dewhurst, J. Chem. Phys. 29, 241-242 (July 1958).
25. "Double-bond formation in paraffinic hydrocarbons in exposures to ionizing radiation," by R. M. Black, J. Applied Chem. 8, 159-163 (May 1958).
26. "Irradiation of polyethylene. II. Kinetics of unsaturated effects," by M. Dole, D. C. Milner, and T. F. Williams, J. Am. Chem. Soc. 80, 1580-1588 (Apr. 5, 1958).
27. "Molecular structure and motion in irradiated polyethylene," by W. P. Slichter and E. R. Mandell, J. Phys. Chem. 62, 334-340 (Mar. 1958).
28. "Effect of pile irradiation on the dynamic properties of polyethylene," by C. W. Deeley, D. E. Kline, J. A. Sauer, and A. E. Woodward, J. Polymer Sci. 28, 109-120 (Feb. 1958).
29. "Irradiated polyethylene insulation systems," by K. J. Mackenzie and R. A. Ward, Electrical Mfg. 61, 56-61 (Jan. 1958).
30. "Radiation processing of unfilled polyester resins," by E. L. Colichman and J. M. Scarborough, J. Applied Chem. 8, 219-223 (Apr. 1958).
31. "Effect of nuclear radiation on fibrous materials. I. Dacron polyester fiber," by O. Teszler and H. A. Rutherford, Textile Res. J. 26, 796-801 (1956).
32. "Formulation of PVC compositions for resistance to intense gamma radiation," by H. Wells and A. Williamson, Brit. Plastics 31, 310-311 (July 1958).
33. "Crosslinking of polyvinyl chloride by ionizing radiation," by C. Wippler, J. Polymer Sci. 29, 585-594 (June 1958).
34. "Coloration of plastics by irradiation," by S. H. Pinner and A. J. Swallow, Plastics (London) 22, 194-195 (June); 268-270 (July 1957).
35. "Irradiation of polycaprolactam with gamma rays and electrons," by G. Majury and S. H. Pinner, J. Applied Chem. 8, 168-171 (Mar. 1958).
36. "Irradiation effects in Plexiglas," by B. Gross, J. Polymer Sci. 27, 135-143 (Jan. 1958).
37. "Poly(vinyl methyl ether) elastomers by high energy radiation," by D. Duffey, Ind. Eng. Chem. 50, 1267-1272 (Sept. 1958).
38. "Elastomers for use in radiation fields," by R. Harrington, Rubber Age 81, 971-980 (Sept.); 82, 461-470 (Dec. 1957); 1003-1015 (Mar. 1958); 83, 472-481 (June 1958).
39. "Synthesis of butadiene-styrene elastomers and polysulfones by gamma radiation," by H. M. d'Emaus, B. G. V. Bray, J. J. Martin, and L. C. Anderson, Ind. Eng. Chem. 49, 1891-1996 (Nov. 1957).
40. "Effect of high doses of ionizing radiations on organic high polymers," by K. Little, Atomic Energy Res. Establ. Report GP/R-1402, 6 pp. (1957).
41. "Effect of various kinds of irradiation on starches," by M. Samic, I. Kosovinc, and H. Reuschl, J. Polymer Sci. 30, 545-550 (July 1958).
42. "Effect of gamma radiation on cellulose," by R. E. Glegg and Z. I. Kertesz, J. Polymer Sci. 26, 289-297 (Dec. 1957).
43. "Effects of radiation on plastic packaging films," by H. G. LeClair and W. H. Cobbs, Jr., Ind. Eng. Chem. 50, 323-326 (Mar. 1958).
44. "How radiation affects six organic coatings," by L. A. Honochs, Materials in Design Eng. 47, 120-123 (Jan. 1958).
45. "Radiation processing," by T. Bain and W. H. T. Davison, Plastics Inst. Trans. 26, 193-206 (Apr. 1958).
46. "Ionizing radiations," by E. A. Burrill, Chemical Eng. 64, 235-241 (Sept. 1957).
47. "Nuclear radiation effects on materials," by G. Reinsmith, ASTM Bulletin No. 232, 37-47 (Sept. 1958).
48. "Radiation-tolerant electronic materials," by V. DeBiasi, Aviation Age 30, 72-74, 76-80 (Aug. 1958).
49. "Radiation damage to plastics," by D. M. Newell, SPE J. 14, 17-21 (July 1958).
50. "Chemical effects in the irradiation of polymers in the solid state," by J. Weiss, J. Polymer Sci. 29, 425-432 (June 1958).

Materials

51. "Reinforced molding with acrylic sirup," by J. A. Ross, B. Mead, and J. T. Rundquist, Modern Plastics 35, 109-112. 194 (Aug. 1958).
52. "Unsaturated polyester resins con-

taining methyl methacrylate monomer," by A. L. Smith and J. R. Lowry, Modern Plastics 35, 134, 136, 138, 140, 142, 200 (Mar. 1958).

53. Acrylic fibers in formable acrylic sheet," by D. E. Jackson and D. A. Moore, Plastics Tech. 3, 716-720 (Sept. 1957).

54. "Formolding acrylic sheet," Modern Plastics 35, 137, 140, 222 (Feb. 1958).

55. "Longest cast acrylic," Modern Plastics 35, 186 (Mar. 1958).

56. "Acrylic pistons," Modern Plastics 35, 183 (Mar. 1958).

57. "Giant acrylic worm feed for chemical blending," Modern Plastics 36, 304 (Nov. 1958).

58. "Plastic phosphor matrix for fast neutron detection," by B. Brown and E. B. Hooper, Jr., Nucleonics 16, 96-98 (Apr. 1958).

59. "Bonding properties of a solventless cyanoacrylate adhesive," by M. J. Bodnar and W. H. Schrader, Modern Plastics 36, 142, 144, 146, 148 (Sept. 1958).

60. "Polymerizable derivatives of long-chain alcohols. Preparation and characterization of copolymers of vinylidene chloride and alkyl acrylates," by E. F. Jordan Jr., W. E. Palm, L. P. Witnauer, and W. S. Port, Ind. Eng. Chem. 49, 1695-1698 (Oct. 1957).

61. "Polymers and group interactions. VI. Intramolecular acylations on copolymers of styrene and acrylic acid derivatives. A route to poly-2,4-methylenetetralone," by Ph. Teyssie and G. Smets, J. Polymer Sci. 27, 441-457 (Jan. 1958).

62. "Preparation, homopolymerization, and copolymerization of alpha-acyloxyacrylic esters," by R. M. Laasko and C. C. Unruh, Ind. Eng. Chem. 50, 1119-1123 (Aug. 1958).

63. "Copolymerizability of ethyl alpha-acetoxyacrylate," by C. C. Unruh and T. M. Laakso, Ind. Eng. Chem. 50, 1124 (Aug. 1958).

64. "Stereospecific vinyl polymerization by asymmetric induction," by N. Beredjick and C. Schuerch, J. Am. Chem. Soc. 80, 1933-1938 (Apr. 20, 1958).

65. "Polymerization of allylic methacrylates. Part 2. Substituted allyl methacrylates, by G. M. Bristow, Trans. Faraday Soc. 54, 1064-1068 (July 1958).

66. "Polymer association. IV. Hydrogen bonding and melt viscosities in copolymer of styrene with methacrylic acid," by R. Longworth and H. Morawetz, J. Polymer Sci. 29, 307-319 (May 1958).

67. "The polymerization of acrylamide with chlorate-sulfite initiator," by T. J. Suen, Y. Jen, and J. V. Lockwood, Journal of Polymer Science. 31, 481-497 (Sept. 1958).

68. "Polyacrylamides derived from cyclic amides," by J. Parrod and J. Elles, J. Polymer Sci. 29, 411-416 (June 1958).

69. "Polymers and copolymers of N-1,1-dihydroperfluoroalkyl acrylamides," by F. W. Knobiick, J. Polymer Sci. 25, 453-464 (Sept. 1957).

70. "Polyacrylamide—a new, synthetic, water-soluble gum," by A. M. Swift, Tappi 40, 224A-227A (Sept. 1957).

71. "Infra-red spectra in high polymers. VII. Polyacrylonitrile," by C. Y. Liang and S. Krim, J. Polymer Sci. 31, 513-522 (Sept. 1958).

72. "Radiochemical polymerization of acrylonitrile," by R. Bensasson and A. Bernas, J. Polymer Sci., 30, 163-173 (July 1958).

73. "Polymerization of acrylonitrile by boron trifluoride in amide solvents," by T. W. Campbell, J. Polymer Sci. 28, 87-96 (Feb. 1958).

74. "Lithium-initiated copolymerization of styrene and methyl methacrylate," by K. F. O'Driscoll, R. J. Boudreau, and A. V. Tobolsky, J. Polymer Sci. 31, 115-121, 123-125 (Aug. 958).

75. "Kinetics of the polymerization of methyl methacrylate in aqueous solution, by B. Atkinson and G. R. Cotton, Trans. Faraday Soc. 54, (June 1958).

76. "Crystalline polymers of methyl methacrylate," by T. G. Fox, B. S. Farrett, W. E. Goode, S. Gratch, J. F. Kincaid, A. Spell, and J. D. Stroupe, J. Am. Chem. Soc. 80, 1768-1769 (Apr. 5, 1958).

77. "Vulcanizable saturated acrylate elastomers," by F. Leonard and J. Brandes, Ind. Eng. Chem. 50, 1053-1058 (July 1958).

78. "Dynamic mechanical properties of poly-n-butyl methacrylate," by W. C. Child, Jr., and J. D. Ferry, J. Colloid Sci. 12, 327-341 (June); 389-399 (Aug. 1957).

79. "Accelerated fatigue testing of polymethyl methacrylate," by J. M. Zarek, Brit. Plastics 30, 399-402, 412 (Sept. 1957).

80. "Fracture phenomena and molecular weight in polymethyl methacrylate," by S. B. Newman and I. Wolock, J. Applied Phys. 29, 49-52 (Jan. 1958).

81. "An elastic creep of polymethyl methacrylate," by O. D. Sherby and J. E. Dorn, J. Mech. and Phys. Solids 6, 145-162 (1958).

82. "Diaphragm behavior of plastics disks," by A. G. H. Dietz and F. J. McGarry, Modern Plastics 36, 135-136, 138-139 (Sept. 1958).

83. "Thermal degradation of polyacrylonitrile, polybutadiene, and copolymers of butadiene with acrylonitrile and styrene," by S. Straus and S. L. Madorsky, J. Research NBS 61, 77-81 (Aug. 1958).

84. "Thermal degradation of polymethacrylonitrile. II. The coloration reaction," by N. Grassie and I. C. McNeill, J. Polymer Sci. 27, 207-218 (Jan. 1958); "III. Structural abnormalities and degradation processes," ibid. 30, 37-46 (July 1958).

85. "Dielectric studies of the methacrylate series. III. Poly-n-hexyl methacrylate IV. Poly-n-octyl methacrylate," by S. Strella and S. N. Chinai, J. Polymer Sci. 31, 45-52 (Aug. 1958).

86. "Conductance of partially neutralized polymethacrylic and polyacrylic acids using a polarization compensated twin cell," by H. Eisenberg, J. Polymer Sci. 30, 47-66 (July 1958).

87. "Structure of crystalline poly (methyl methacrylate)," by J. D. Stroupe and R. E. Hughes, J. Am. Chem. Soc. 80, 2341-2342 (May 5, 1958).

88. "Alkaline hydrolysis of polyacrylates," by W. Cooper, Chem. and Ind. 9, 262 (Mar. 1, 1958).

89. "Poly-n-hexyl methacrylate. IV. Dilute solution properties by viscosity and light scattering," by S. N. Chinai, J. Polymer Sci. 25, 413-427 (Sept. 1957).

90. "Determination of poly(ethyl-esters) in methyl methacrylate copolymers," by J. Haslam, J. B. Hamilton, and A. R. Jeffa, Analyst 83, 66-71 (1958).

91. "Storage stability of cellulose nitrate," by G. R. Rugger, SPE J. 14, 29-31 (July 1958).

92. "Surveillance of cinematograph record film during storage," by G. L. Hutchinson, L. Ellis, and J. A. Ashmore, J. Applied Chem. 8, 24-34 (Jan. 1958).

93. "Thermal decomposition of cellulose nitrate. IV. C_{14} tracer experiments," by F. Shafizadeh and M. L. Wolfrom, J. Am. Chem. Sci. 80, 1675-1677 (Apr. 5, 1958).

94. "Ultrasonic degradation of cellulose nitrate. II. Effects of temperature, solvent, and other process variables," by B. B. Thomas and W. J. Alexander, J. Polymer Sci. 25, 285-304 (Aug. 1957).

95. "Formation of crosslinks in cellulose during nitration," by H. Sihtola, B. Anthoni, and N. E. Virkola, J. Polymer Sci. 30, 1-4 (July 1958).

96. "Molecular size and configuration of cellulose trinitrate in solution," by M. M. Huque, D. A. I. Goring, and S. G. Mason, Canadian J. Chem. 36, 952-969 (June 1958).

97. "Determination of sulfate acid ester in unstabilized cellulose nitrate by the hydrolysis method," by P. E. Gagnon, K. F. Keirstead, and B. T. Newbold, Canadian J. Chem. 36, 291-295 (Feb. 1958).

98. "Press-less laminating," Modern Plastics 35, 104 (May 1958).

99. "Studies on the sorption of moisture by polymers, II. The cellulose acetate systems," by D. K. Beever and L. Valentine, J. Applied Chem. 8, 103-107 (Feb. 1958).

100. "Investigation on the determination of the acetic acid yield of cellulose acetate," by C. A. Redfarn, Plastics (London) 23, 33-36 (Jan. 1958).

101. "Viscoelasticity of some cross-linked polymers," by N. Tokita and K. Kanamaru, J. Polymer Sci. 27, 255-267 (Jan. 1958).

102. "Thermodynamic properties of solutions of cellulose derivatives. I. Dilute solutions of secondary cellulose acetate," by W. R. Moore and B. M. Tidswell, J. Polymer Sci. 27, 459-472 (Jan. 1958).

103 "Molecular and crystal structure of cellulose triacetate," by W. J. Dulmage, J. Polymer Sci. 26, 277-288 (Dec. 1957).

104. "Molecular weight of ethyl cellulose by dielectric constants," by P. C. Scherer, M. C. Hawkins, and D. L. Levy, J. Polymer Sci. 31, 105-113 (Aug. 1958).

105. "Relationship between viscosity and molecular weight of ethyl cellulose," by W. R. Moore and A. M. Brown, J. Applied Chem. 5, 363-367 (June 1958).

106. "Sorption and diffusion in ethyl cellulose. Part IV. Water in ethyl cellulose," by R. M. Barrer and J. A. Barrie, J. Polymer Sci. 28, 377-386 (Mar. 1958).

107. "Molecular weight of ethyl cellulose by dielectric dispersion of solutions in dioxane," by P. C. Scherer,

M. C. Hawkins, and D. W. Levi, J. Polymer Sci. 27, 129-134 (Jan. 1958).

108. "Sorption and diffusion in ethyl cellulose. Part III. Comparison between ethyl cellulose and rubber," by R. M. Barrer, J. A. Barrie, and J. Slater, J. Polymer Sci. 27, 177-197 (Jan. 1958).

109. "Viscosities of concentrated polymer solutions. IV. Cellulose tributyrate," by R. F. Landel, J. W. Berge, and J. D. Ferry, J. Colloid Sci. 12, 400-411 (Aug. 1957).

110. "Synthesis of some new esters and ethers of cellulose and examination of their properties," by Z. A. Rogovin, J. Polymer Sci. 30, 537-544 (July 1958).

111. "Reactivities of lower aliphatic anhydrides toward hydroxyl groups of cellulose," by C. J. Malm, L. J. Tanghe, H. M. Herzog, and M. H. Stewart, Ind. Eng. Chem. 50, 1061-1066 (July 1958).

112. "Thermodynamic properties of dilute solutions of cellulose derivatives," by W. R. Moore and B. M. Tidswell, J. Polymer Sci. 29, 37-52 (May 1958).

113. "Intrinsic viscosities of cellulose derivatives," by P. J. Flory, O. K. Spurr, Jr., and D. K. Carpenter, J. Polymer Sci. 27, 231-240 (Jan. 1958).

114. "Thermal degradation of cellulosic materials," by S. L. Madorsky, V. E. Hart, and S. Straus, J. Research NBS 60, 343-349 (Apr. 1958).

115. "Degradation of cellulose in a vacuum with ultraviolet light," by J. H. Flynn, W. K. Wilson, and W. L. Morrow, J. Research NBS 60, 229-233 (Mar. 1958).

116. "An equation for calculating the number of chain scissions in the photochemical degradation of solid polymer," by J. H. Flynn, J. Polymer Sci. 27, 83-86 (Jan. 1958).

117. "Paper mills roll with new starch sizings," Chem. Week 82, 49 (Feb. 22, 1958).

118. "Lignin—A symposium," Ind. Eng. Chem. 49, 1377-1408 (Sept. 1957).

119. "Epoxy makers seek their second wind," Chem. Week 83, 31-33 (Sept. 13, 1958).

120. "New epoxy resins," by J. D. Bassin, SPE J. 14, 36-38, 40 (May 1958).

121. Epoxies in fourth dimension, Modern Plastics 36, 39, 41 (Nov. 1958).

122. "New epoxy molding compound," by H. J. Doyle and C. F. Molby, Materials in Design Eng. 47, 106-109 (May 1958).

123. "Some characteristics of epoxide resin systems," by F. J. Allen and W. M. Hunter, J. Applied Chem. 7, 86-87 (Feb. 1957).

124. "Polyepoxide resins, their chemical reactions and physical properties," by M. G. Ivinson, B. R. Howe, and F. M. Karpfen, J. Applied Chem. 7, 118-122 (Mar. 1957).

125. "Optimum aromatic amine-hardened epoxy-glass laminates," by H. Raech, Jr. and F. F. Harris, Plastics Tech. 4, 448-455 (May 1958).

126. "Aggregate reinforcements for cast epoxies," by J. Delmonte, SPE J. 13, 23-24 (Aug. 1957).

127. "Effects of fillers on high humidity insulation resistance of epoxy resin systems," by H. L. Parry, J. E. Carey, and M. D. Anderson, SPE J. 13, 45-47 (Oct. 1957).

128. "Bis(aminophenyl)sulfones as curing agents for epoxy resins," by W. H. C. Rueggeberg, J. E. Singley, C. E. Feazel, and E. A. Verchot, Modern Plastics 35, 151, 156, 228 (Feb. 1958).

129. "Aromatic amines as curing agents," by W. Bandaruk, Plastics World 15, 6-8 (Nov. 1957).

130. "Controlled boron trifluoride catalysis of epoxy polymerizations," by H. B. Wagner, J. Polymer Sci. 26, 329-332 (Dec. 1957).

131. "Cure shrinkage of epoxy systems," by H. L. Parry and H. A. Mackay, SPE J. 14, 22-24 (July 1958).

132. "A simple technique for use with infra-red spectroscopy to study the curing of epoxy resins," by C. E. Feazel and E. A. Verchot, J. Polymer Sci. 25, 351-353 (Aug. 1957).

133. "A control program for epoxy-caused dermatitis," by J. A. Stifter, Plastics Tech. 4, 138-141, 148 (Feb. 1958).

134. "Dermatosis and epoxy resins," by E. N. Dorman, SPE J. 13, 25-26 (Aug. 1957).

135. "Vinyl epoxy plasticizers. The epoxyhexahydrophthalates," by F. P. Greenspan and R. J. Gall, Chem. Eng. News 50, 865-867 (June 1958).

136. "New and modified epoxy stabilizers," by D. E. Winkler, Ind. Eng. Chem. 50, 863-864 (June 1958).

137. "Epoxidized esters of glycols and pentaerythritol. Applications as plasticizers for polyvinyl chloride," by E. J. Hensch and A. G. Wilbur, Ind. Eng. Chem. 50, 871-872 (June 1958).

138. "Epoxy plasticizer for PVC," by T. C. Moorshead, Plastics (London) 22, 343-345 (Aug. 1957).

139. "Argentimetric method for epoxides," by G. A. Stenmark, Analytical Chem. 29, 1367-1369 (Sept. 1957).

140. "Determination of alpha-glycol content of epoxy resins," by G. A. Stenmark, Analytical Chem. 30, 381-383 (Mar. 1958).

141. "Electrical properties of modified epoxy resins," by J. Delmonte, Modern Plastics 35, 152, 154, 156, 229 (Apr. 1958).

142. "Arc resistance of epoxies," by J. Delmonte, Plastics Tech. 4, 228-230 (Mar. 1958).

143. "Relationship between electrical and mechanical properties of epoxy plastics," by J. Delmonte, ASTM Bulletin No. 224, 32-35 (Sept. 1957).

144. "Studies of straining of high polymer solids," by K. Ito, J. Polymer Sci. 27, 419-431 (Jan. 1958).

145. "Some thermal aspects of epoxy resins," by E. Klopfenstein, Insulation 4, 13-16 (Feb. 1958).

146. "Evaluating epoxy resin degradation systems," by W. G. Murray and G. A. Stein, Plastics Tech. 4, 143-148 (Feb. 1958).

147. "Dollar-saving tools," Modern Plastics 36, 166-167 (Nov. 1958).

148. "Epoxy-alloy for metal forming," Modern Plastics 35, 196 (Apr. 1958).

149. "Cutting production cost and time with epoxy resin press dies," by J. J. Mele, Plastics Tech. 4, 232-234 (Mar. 1958).

150. "Plastic-faced dies for metal-forming," by J. Delmonte, Design Digest D9 (Mid-Oct. 1957).

151. "How epoxies are used to improve large and small transformer designs," by W. W. Wahlgren, Insulation 4, 15-17 (June 1958).

152. "Cold setting plastic now used for metallographic mounting," by N. J. Gendron, Industrial Labs., 9, 26-27 (June 1958).

153. "Encapsulating airborne electronics," by L. A. Dixon, Jr., SPE J. 14, 34-35 (May 1958).

154. "Vacuum-molded epoxy cast-resin

applications," by H. R. Lucas, Electrical Mfg. *61*, 98-100 (Apr. 1958).
155. "Epoxy casting resins for electrical applications," by W. E. Weber, SPE J. *14*, 49-52, 57 (Mar. 1958).
156. "Evaluation of casting resins employing strain gage techniques," by R. N. Sampson and J. P. Lesnick, Modern Plastics *35*, 150, 153, 225-226 (Feb. 1958).
157. "Epoxy coating improves cameras," Modern Plastics *35*, 89 (July 1958).
158. "Epoxide resins versus corrosion," by L. M. Barakan and G. L. E. Wild, Corrosion Tech. *5*, 137-140 (May 1958).
159. "Epoxy resins in corrosion-resistant applications," by P. A. Dunn, Corrosion Tech. *5*, 143-147 (Mar. 1958).
160. "Reinforced epoxy spray masks for two-tone painting," by C. B. Martin, Plastics Tech. *4*, 41-43, 59 (Jan. 1958).
161. "Oxidative degradation of epoxy resin coatings," by W. R. R. Park and J. Blount, Jr., Ind. Eng. Chem. *49*, 1897-1902 (Nov. 1957).
162. "Conductive adhesive for electronic applications," by T. J. Kilduff and A. A. Benderly, Electrical Mfg. *61*, 148-152 (June 1958).
163. "Molecular structure as a basis for adhesion. Ultracentrifugal measurement of the adhesion of epoxy polymers," by H. Alter and W. Soller, Industrial and Engineering Chemistry *50*, 922-927 (June 1958).
164. "Improved impact epoxy adhesives," by S. S. Stivala and W. J. Powers, Ind. Eng. Chem. *50*, 935-938 (June 1958).
165. "Vinyl-metal laminates," by T. C. Moorshead, Rubber and Plastics Age *39*, 49-50 (Jan. 1958).
166. "Glass-reinforced epoxy springs offer strength, energy absorption," Materials in Design Eng. *47*, 12, 196 (Feb. 1958).
167. "Epoxies' big potentials," by E. N. Dorman and M. M. Gruber, Modern Plastics *36*, 156-160 (Nov. 1958).
168. "Epoxy resins as cryogenic structural adhesives," by R. M. McClintock and M. J. Hiza, Modern Plastics *35*, 172-174, 176, 237 (June 1958).
169. "A new method to 'lock-in' elastic effects for experimental stress analysis," by J. W. Dally, A. J. Durelli, and W. F. Riley, J. Applied Mech. *25*, 186-195 (June 1958).
170. "Polyethylene growth rate: 30 percent," Chem. Eng. News *35*, 32-33, (Sept. 1957).
171. "When you want polyethylene, know what you want," Modern Plastics *36*, 83-87, 186, 188, 191-192, 194, 196, 199, 201-202 (Oct.); 98-102, 194, 196, 202 (Dec. 1958).
172. "What's happening to linear polyethylene?" Chemical Eng. *65*, 86, 88, 90 (Sept. 22, 1958).
173. "Choosing and forming polyethylene sheet," by A. G. Rowe, Modern Plastics *35*, 113-114, 116, 120, 196, 198 (Aug. 1958).
174. "The polyolefin plastics field—present technical status," by F. C. McGrew, Modern Plastics *35*, 125-126, 128, 130, 133 (Mar. 1958).
175. "The new polyethylenes," by M. W. Riley, Materials in Design Eng. *48*, 98-102 (July); 96-100 (Aug. 1958).
176. "Medium density polyethylenes," by F. C. Sutro, Jr., SPE J. *14*, 29-32 (Aug. 1958).
177. "Plastics from petroleum-based chemicals," by K. C. Bryant, Plastics Inst. Trans. *26*, 174-186, (Apr. 1958).
178. "Effect of processing conditions upon specific gravity of high density polyethylene," by J. P. Fogarty and E. Poindexter, SPE J. *14*, 41-44 (Apr. 1958).
179. "Polyethylene sires a rugged new hybrid," Chem. Week *82*, 69-70, 72 (Apr. 2, 1958).
180. "Additives check oxidation," Chem. Eng. News *36*, 58-59 (Feb. 24, 1958).
181. "Reinforced thermoplastic sheet," by J. V. Eurich, Plastics (London) *23*, 51-52 (Feb. 1958).
182. "Rubber-Marlex 50 polyethylene blends," by Railsback and Wheat, Rubber Age *82*, 664-671 (Jan. 1958).
183. "Higher density polyethylenes," by G. H. Sollenberger, SPE J. *14*, 23-24, 64 (Jan. 1958).
184. "Polyethylene: preparation, structure, and properties," by S. L. Aggarwal and O. J. Sweeting, Chem. Rev. *57*, 665-742 (Aug. 1957).
185. "Continuous oxygen-initiated ethylene polymerization," by F. N. Grimsby and E. R. Gilliland, Ind. Eng. Chem. *50*, 1049-1052 (July 1958).
186. "Polymerization of olefins by complex metal catalysts," by J. K. Stille, Chem. Rev. *58*, 541-580 (June 1958).
187. "Catalytic structure and polymer properties in polyethylene type polymers," by E. G. Curphey, Plastics (London) *23*, 189-190 (May 1958).
188. "Polymerization of ethylene by low valent compounds of titanium," by D. B. Ludlum, A. W. Anderson, and C. E. Ashby, Journal of the American Chemical Society *80*, 1380-1384 (Mar. 20, 1958).
189. "Polymerization of ethylene in the presence of titanium tetrachloride and certain metal alkyls," by J. C. McGowan and B. M. Ford, J. Chem. Soc. *1958*, 1149-1152 (Mar.).
190. "Studies on the low pressure polymerization of ethylene using catalysts containing lithium alkyls," by M. Frankel, J. Rabani, and A. Zilkha, J. Polymer Sci. *28*, 387-394 (Mar. 1958).
191. "Pilot plant development of a polyethylene process," by M. R. Cines, G. H. Dale, E. W. Mellow, and R. E. Weis, Chem. Eng. Progress *54*, 95-98 (Feb. 1958).
192. "Supported oxide catalysts in the production of polymers," by E. G. Curphey, Brit. Plastics *31*, 63-65 (Feb. 1958). 1958).
193. "Polymers and copolymers of sodium ethylenesulfonate," by D. S. Breslow and A. Kutner, J. Polymer Sci. *27*, 295-312 (Jan. 1958).
194. "Zeigler type catalysts for polymerization processes," by E. G. Curphey, Brit. Plastics *30*, 486-489 (Nov. 1957).
195. "Mold design for high-density polyethylene," by A. Spaak, Plastics Tech. *3*, 537-541 (June 1958).
196. "Techniques for molding linear polyethylene," by D. A. Jones, Plastics Tech. *3*, 547-551 (June 1958).
197. "Molding linear polyethylene," by A. Spaak and C. L. Weir, Modern Plastics *35*, 122, 124-125, 128-129 (Apr. 1958).
198. "New techniques in molding high density polyethylene," by D. A. Jones, Brit. Plastics *31*, 152-155 (Apr. 1958).
199. "Mold design technology for polyethylene," by R. W. Van Sickle, Plastics Tech. *4*, 35-40 (Jan. 1958).
200. "Extrusion of clear film from high density polyethylene," by R. Doyle, SPE J. *14*, 35-39 (June 1958).
201. "Extrusion and forming of high-

density polyethylene blown tubing," by R. Doyle, Modern Plastics *35*, 137, 140, 142-143 (May 1958).

202. "Flow properties of polyethylene and their effect on fabrication," by P. L. Clegg, Plastics Inst. Trans. *26*, 151-171 (Apr. 1958); Brit. Plastics *30*, 535-537 (Dec. 1957).

203. "Effect of blow-up ratio on properties of polyethylene blown film," by C. G. Kucher, Plastics Tech. *3*, 711-713, 720 (Sept. 1957).

204. "Flow behavior and turbulence in polyethylene," by R. F. Westover and B. Maxwell, SPE J. *13*, 27-35 (Aug. 1957).

205. "How to slush mold polyethylene," Modern Plastics *35*, 112-114 (May 1958).

206. "Molding dry-colored polyethylene," by C. L. Weir, Modern Plastics *35*, 97-99, 102-103 (July 1958).

207. "Dry-coloring methods for injection molding of polyethylene," by J. N. Scott, C. J. Silas, and J. V. Smith, Plastics Tech. *3*, 552-555 (June 1958).

208. "A new breaker plate for coloring polyethylene," by J. E. Simpson, SPE J. *14*, 27-30 (Mar. 1958).

209. "The problems of printing polyethylene," by H. A. Scopp, Plastics World *15*, 8 (Dec. 1957).

210. "New methods for bonding polyethylene to rubber, brass, and brass-plated metals," by H. Peters and W. H. Lockwood, Rubber World *138*, 418-423, 426 (June 1958); Plastics (London) *23*, 228-231 (June 1958).

211. "Effects of oxidation on adhesion of polyethylene to metals," by Bockhoff, McDonel, and Rutzler, Jr., Ind. Eng. Chem. *50*, 904-907 (June 1958).

212. "Adhesive bonding of polyethylene," by W. H. Schrader and M. J. Bodner, Plastics Tech. *3*, 988-990 (Dec. 1957).

213. "Polyethylene heat-seal factors," by R. M. Knight, E. E. Froste, and W. U. Funk, Modern Packaging *31*, 152-156 (Apr. 1958).

215. "Dry cleaning: big new market for film." Modern Plastics *35*, 106-107 (Apr. 1958).

216. "Housewares," Modern Plastics *35*, 75-79, 167-168, 170 (July 1958).

217. "Markets for polyethylene pipe." by J. E. Sayre, Modern Plastics *35*, 82-87 (July 1958).

218. "Polyethylene pipe in pneumatic breakwater," Rubber and Plastics Age *39*, 591 (July 1958).

219. "The polyethylene bread wrap," Modern Plastics *35*, 118-119, 227-228 (June 1958).

220. "Polyethylene overwrap film," by R. Doyle and R. J. Martinovich, Modern Packaging *31*, 215-220, 302, 304, 306 (May 1958).

221. "Savings in shipping carnations," Modern Plastics *35*, 108-109 (Feb. 1958).

222. "Polyethylene film for fruit," by A. E. Hardenburg, H. A. Schomer, and M. Uota, Modern Packaging *31*, 135-144, 197 (Feb. 1958).

223. "Polyethylene-wax coatings," by G. S. Peacock, W. H. McKnight, and J. M. Austin, Modern Packaging *31*, 137-142 (Jan. 1958).

224. "Polyethylene tote boxes," Modern Plastics *35*, 160 (July 1958).

225. "Polyethylene for marine applications," Modern Plastics *35*, 94-95 (Aug. 1958).

226. "'Wet' motors tackle pump seal problems," Chem. Week *83*, 57-58 (Sept. 6, 1958).

227. "The moderator is polyethylene," Modern Plastics *35*, 90-91 (July 1958).

228. "Equipment can now don polyethylene coat," Chem. Eng. *65*, 152, 154 (Sept. 1958).

229. "Protective coatings from polythene powder," Rubber and Plastics Age *39*, 598-599 (July 1958); Corrosion Tech. *5*, 173-175 (June 1958).

230. "Low molecular weight polyethylene in rubber compounding," by T. A. Bulifant, Rubber and Plastics Age *39*, 206-207, 209, 205 (Mar. 1958).

231. "Big tanks injection molded," Modern Plastics *36*, 150-153 (Nov. 1958).

232. "Bonanza for extruders," Modern Plastics *36*, 146 (Nov. 1958).

233. "Polyethylene cartridges," Modern Plastics *36*, 91, 192 (Dec. 1958).

234. "The radiography of polythene," by D. C. Shotton, Brit. Plastics *31*, 249-252, 262 (June 1958).

235. "Evaluation of carbon black dispersions in polyethylene to predict weatherability," by R. M. Schulken, Jr., G. C. Newland, and J. W. Tamblyn, Modern Plastics *35*, 125-128, 130, 200 (Aug. 1958).

236. "Early detection of weathering damage in polyethylene," by F. W. Tamblyn, G. C. Newland, and M. T. Watson, Plastics Tech. *4*, 427-432, 455 (May 1958).

237. "Creep and stress-rupture behavior of polyethylene resins," by R. H. Carey, Ind. Eng. Chem. *50*, 1045-1048 (July 1958).

238. "Low-temperature brittleness testing of polyethylene," by P. N. Bestelink and S. Turner, ASTM Bulletin No. 231, 68-73 (July 1958).

239. "Tensile properties of fractionated high density polyethylenes," by L. H. Tung, SPE J. *14*, 25-28 (July 1958).

240. "Mechanical properties of thin polyethylene film," by A. A. Anderson and G. L. Morfitt, Modern Plastics *35*, 139, 142, 144, 147-148, 222, 224, 226 (Apr. 1958).

241. "A study of the low-temperature brittleness testing of polyethylene," by E. A. W. Hoff and S. Turner, ASTM Bulletin No. 225, 58-64 (Oct. 1957).

242. "Treeing effects in polyethylene," by O. S. Pratt, Electrical Eng. *77*, 218-223 (Mar. 1958).

243. "Diffusion of benzene in rubber and polyethylene," by R. M. Barrer and R. R. Fergusson, Trans. Faraday Soc. *54*, 989-1000 (July 1958).

244. "Diffusion in ethylene polymers. I. Desorption kinetics for a thin slab," by D. W. McCall, J. Polymer Sci. *26*, 151-164; "II. Desorption of water," by D. W. McCall, J. F. Ambrose, and V. L. Lanza, ibid. 165-169 (Nov. 1957); "III. Effects of temperature and pressure," by D. W. McCall and W. P. Slichter, J. Am. Chem. Soc. *80*, 1861-1868 (Apr. 20, 1958).

245. "Determination of moisture permeation rate through polythene cable glands," by D. W. Glover and A. J. Claever, Brit. Plastics *31*, 105-106 (Mar. 1958).

246. "Application of Larson-Miller correlation to service test data on high-density polyethylene," by W. E. Gloor, Modern Plastics *36*, 144, 146, 148, 214 (Oct. 1958).

247. "Testing of Ziegler-polyethylene pipes," by K. Richard, G. Diedrich, and E. Gaube, Rubber and Plastics Age *39*, 364-365, 367-368 (May 1958).

248. "Fractionation of polyethylene," by P. S. Francis, R. C. Cooke, Jr., and J. H. Elliott, J. Polymer Sci. *31*, 453-466 (Sept. 1958).

249. "Peroxide crosslinked carbon black polyethylene compositions," by E. M.

Dannenberg, M. E. Jordan, and H. M. Cole, J. Polymer Sci. *31*, 127-153 (Aug. 1958).

250. "Molecular weight of polyethylene and of other high-molecular-weight organic compounds," by R. Tremblay, A. F. Sirianni, and I. E. Puddington, Canadian J. Chem. *36*, 725-730 (May 1958).

251. "An evaluation of molecular weight distribution in high pressure polyethylene," by C. Mussa IV. J. Polymer Sci. *28*, 587-610 (Apr. 1958).

252. "The fractionation of polyethylene," by S. W. Hawkins and H. Smith, J. Polymer Sci. *28*, 341-353 (Mar. 1958).

253. "Regular spin resonance line width measurements of polyethylene," by R. L. Collins, J. Polymer Sci. *27*, 67-73 (Jan. 1958).

254. "Thermodynamics of crystallization in high polymers: Polyethylene," by F. A. Quinn, Jr. and L. Mandelkern, J Am. Chem. Soc. *80*, 3178-3182 (July 5, 1958).

255. "Crystalline recovery of quenched polyethylene," by R. L. Collins, J. Polymer Sci. *27*, 75-82 (Jan. 1958).

256. "Polypropylene plant on stream," Modern Plastics *35*, 37, 39 (Jan. 1958).

257. "Molecular motion in polypropylene, isotactic and atactic," by W. P. Slichter and E. R. Mandell, J. Chem. Phys. *29*, 232-233 (July 1958).

258. "Injection molding and extrusion of Moplen," by A. Bosoni, Plastics Tech. *3*, 556-559 (June 1958).

259. "What's with polypropylene?" by M. Ottolenghi and C. Crespi, Modern Plastics *35*, 89-92 (Mar. 1958).

260. "Bromine number of propylene and butylene polymers," by J. C. S. Wood, Analytical Chem. *30*, 372-375 (Mar. 1958).

261. "Polypropylene," Plastics (London) *23*, 41-45 (Feb. 1958).

262. "Polypropylene, a promising new plastic," by C. Crespi, Materials in Design Eng. *47*, 110-114 (Jan. 1958).

263. "Properties of polypropylene," Materials in Design Eng. *46*, 164, 166-167 (Dec. 1957).

264. "Teflon resin easier to extrude; available as film and powder," by R. S. Mallouk and W. B. Thompson, Materials in Design Eng. *47*, 171, 173-174, 176 (Apr. 1958).

265. "Fluorocarbon plastics take on new jobs," by R. B. Norden, Chem. Eng. *65*, 158, 160, 162 (Aug. 11, 1958).

266. "Selection and design of fluorocarbon plastics," by M. W. Riley, Materials and Methods *45*, 129-148 (June 1957).

267. "New specialty rubber to be coming soon," Chem. Eng. News *36*, 24-25 (Mar. 24, 1958).

268. "Organic fluorine rubbers," by J. C. Tatlow, Rubber and Plastics Age *39*, 33-36 (Jan. 1958).

269. "Vinylidene fluoride-hexafluoropropylene copolymer, a thermally stable elastomer," by S. Dixon, D. R. Rexford, and J. S. Rugg, Ind. Eng. Chem. *49*, 1687-1690 (Oct. 1957).

270. "The fluoro-elastomers," by M. W. Riley, Materials and Methods *46*, 90-98 (July 1957).

271. "Designing with Teflon," Machine Design *29*, 86-95 (Sept. 5); 162-167 (Sept. 19); 124-131 (Oct. 3); 124-130 (Oct. 17, 1957).

272. "Machining TFE resins," by J. J. Kipnes, Modern Plastics *35*, 123-125, 128, 130, 132, 232-233 (May 1958).

273. "Bonding of Teflon," by E. R. Nelson, T. J. Kilduff, and A. A. Benderly, Ind. Eng. Chem. *50*, 329-330 (Mar. 1958).

274. "Teflon (tetrafluoroethylene) fiber," by J. T. Rivers and R. L. Franklin, Textile Res. J. *26*, 805-811 (1956).

275. "Thin films of polytetrafluoroethylene resin as lubricants and preservative coatings for metals," by V. G. Fitzsimmons and W. A. Zisman, Ind. Eng. Chem. *50*, 781-784 (May 1958).

276. "Teflon coatings expand," Chem. Eng. News *36*, 48-49 (Oct. 13, 1958).

277. "Halofluorocarbon plastics," by R. A. Smith, J. H. Kushnik, and H. S. Kaufman, Modern Packaging *31*, 131-134, 136, 177-178 (June 1958).

278. "Teflon bellows," Modern Plastics *35*, 218 (May 1958).

279. "Teflon-based piston rings for nonlubricated applications," by R. D. Taber and F. A. Robbins, Mechanical Eng. *79*, 838-841 (Sept. 1957).

280. "Thermal stability of polytetrafluoroethylene," by C. R. Patrick, Nature *181*, 698 (1958).

281. "The fine structure of polytetrafluoroethylene," by C. W. Bunn, A. J. Cobbold, and R. P. Palmer, J. Polymer Sci. *28*, 365-376 (Mar. 1958).

282. "Dielectric properties of polymonochlorotrifluoroethylene," by T. Nakajima and S. Saito, J. Polymer Sci. *31*, 423-437 (Sept. 1958).

283. "Influence of the solvent on the polymerization velocity of trifluorochloroethylene," M. Lazar, J. Polymer Sci. *29*, 573-578 (June 1958).

284. "Specific volume and degree of crystallinity of semi-crystalline poly-(chlorotrifluoroethylene), and estimated specific volumes of the pure amorphous and crystalline phases," by J. D. Hoffman and J. J. Weeks, J. Research NBS *60*, 465-479 (May 1958).

285. "Preparation and polymerization of perfluoroalkyl propenyl ketones," by D. A. Rausch, L. E. Coleman, Jr., and A. M. Lovelace, J. Am. Chem. Soc. *79*, 4983-4984 (Sept. 20, 1957).

286. "How big is urethane?", Modern Plastics *35*, 190-191 (July 1958).

287. "Polyesters of dimer acids as intermediates for urethane foams," by R. D. Ayleswoth, R. H. Boehringer, D. T. Moore, and M. H. Smith, Modern Plastics *35*, 145-146, 148, 150, 152, 154 (May 1958).

288. "Developments in polyurethanes, unsaturated polyesters, polyvinyl chloride, and acrylonitrile copolymer blends. 1957," by W. Cummings and R. L. Knapp, Plastics Tech. *4*, 241-244 (Mar. 1958).

289. "A new family of heat-resistant urethane polymers," by V. V. D'Ancicco, SPE J. *14*, 34-36 (Feb. 1958). Industrial Lab. *8*, 66-71 (Nov. 1957).

290. "Polyurethane foams," by H. K. Frensdorff, Rubber Age *83*, 812-818 (Aug. 1958).

291. "Compounding polyurethanes," by R. J. Ferrari, J. W. Sinner, J. C. Bill, and W. F. Brucksch, Ind. Eng. Chem. *50*, 1041-1044 (July 1958).

292. "The polyurethane foam process," by J. T. Watts, Plastics Inst. Trans. *26*, 289-298 (July 1958).

293. "Effects of TDI isomer ratio in polyurethane foam," by G. T. Gmitter and E. E. Gruber, Rubber Age *83*, 83-87 (Apr. 1958).

294. "Foamed-in-place techniques with sebalkyd and flexalkyd resins," by A. C. Cornwell, D. B. V. Parker, and L. N. Phillips, Brit. Plastics *30*, 392-397 (Sept. 1957).

295. "Automotive engineering with

urethane foam," by R. H. Walsh, Rubber World *136*, 386-390 (June 1957).
296. "Encased in urethane foam," Modern Plastics *36*, 89 (Oct. 1958).
297. "Radiation absorbers," Modern Plastics *35*, 200 (Apr. 1958).
298. "Foamed plastics for structural functions in electronic equipment," by R. Thieman, Electrical Mfg. *61*, 67-73 (Jan. 1958).
299. "Polyurethane rigid foams," by R. Hurd, J. Refrigeration *1*, 59-62 (Mar./Apr. 1958).
300. "New surface coatings based on triisocyanates," by M. E. Bailey, SPE J. *14*, 41-43 68 (Feb. 1958).
301. "Urethane: Equipment jobs seen," Chem. Eng. News *36*, 76, 77 (June 30, 1958).
302. "Further developments in the the 'Vulkollan' field," by E. Muller, Rubber and Plastics Age *39*, 195, 197, 199-200, 203, 205 (Mar. 1958).
303. "Polyurethane VC, a virtually cross-linked elastomer," by C. S. Schollenberger, H. Scott, and G. R. Moore, Rubber World *137*, 549-555 (Jan. 1958).
304. "Cast urethane rubber" by R. H. Kittner and K. A. Pigott, Product Eng. *28*, 68-71 (Sept. 16, 1957).
305. "Carpets of flowers," Modern Plastics *36*, 105 (Dec. 1958).
306. "Properties required of thermosets for automatic molding," by F. J. Donohue, Modern Plastics 35, 104, 106, 108, 174-175 (July 1958).
307. "New developments in the manufacture of phenolic molding materials," by E. Schneider and D. H. M. Brooks, Plastics Inst. Trans. *26*, 117-136 (Apr. 1958).
308. "Resin-silica versus missile-made heat," Chem. Eng. *65*, 74, 76 (Jan. 27, 1958).
309. "Where to use rubber phenolic moldings," by E. J. Thomas, Materials in Design Engineering *46*, 120-123 (Dec. 1957).
310. "When to specify phenolic-glass moldings," by P. Fina, Materials in Design Eng. *46*, 116-120 (Aug. 1957).
311. "Best results with phenolic molded parts," by D. M. Buchanan, Product Eng. *29*, 44-46 (Sept. 1, 1958).
312. "Phenolic for complex detail," Modern Plastics *35*, 80-81 (July 1958)
313. "Blower wheels: new field for phenolics," Modern Plastics *35*, 118-119 (May 1958).
314. "Properties of phenolic, epoxy, and vinyl coatings," Materials in Design Eng. *47*, 161, 163 (Apr. 1958).
315. "Titanium under glass," Chem. Week *82*, 40 (May 24, 1958).
316. "Phenolic coatings for metal products," by R. B. Young, Materials and Methods *45*, 106-109 (Jan. 1957).
317. "Room-temperature-cured resorcinol epoxide adhesives for metals," by W. E. St. Clair and R. H. Moult, Ind. Eng. Chem. *50*, 908-911 (June 1958).
318. "Metal surface effects on heat resistance of adhesive bonds," by J. M. Black and R. F. Blomquist, Ind. Eng. Chem. *50*, 918-921 (June 1958).
319. "Resorcinol-formaldehyde latex adhesives for bonded synthetic tire cords," by M. I. Dietrick, Rubber World *136*, 847-850 (Sept. 1957).
320. "A general method for the preparation of phenolic polystyrenes," by R. Stern, J. English, and H. G. Cassidy, J. Am. Chem. Soc. *79*, 5792-5797 (Nov. 5, 1957).
321. "Polymerization of 4-*t*-butyl-2-cyclohexylaminomethyl phenol," by W. J. Burke, B. A. Barton, P. D. Gardner, and J. D. Lewis, J. Am. Chem. Soc. *80*, 3438-3443 (July 5, 1958).
322. "Chemical interactions in the polyvinyl formal-phenolic resin system," by S. M. Cohen, R. E. Kass, and E. Lavin, Ind. Eng. Chem. *50*, 229-232 (Feb. 1958).
323. "Preparation of 'high ortho' novolak resins. I. Metal ion catalysis and orientation effect," by D. A. Fraser, R. W. Hall, and A. L. J. Raum, J. Applied Chem. 7, 676-689 (Dec. 1957).
324. "Versamid resins have hosts of uses," Modern Plastics *35*, 230 (Apr. 1958).
325. "Characteristics of the polyamide-epoxy resin system," by D. E. Floyd, D. E. Perman, and H. Wittcoff, J. Applied Chem. 7, 250-260 (May 1957).
326. "Polyhomologous ring amides in polycaprolactam," by M. Rothe, J. Polymer Sci. *30*, 227-238 (July 1958).
327. "Unsaturated polyamides and their copolymers," by R. Mihail, S. Bittman, and A. Rizea, J. Polymer Sci. *30*, 423-429 (July 1958).
328. "Copolyamides containing bis-amidemethylene groups," by A. Cannepin, J. Polymer Sci. *29*, 621-628 (June 1958).
329. "New nylon from France," by J. Fouque, Product Eng. *28*, 76-79 (Dec. 23, 1957).
330. "Properties and fabricating of nylon-11," by F. Chapman, Plastics (London) *22*, 4-6-409 (Oct. 1957).
331. "Nylon in power couplings," Modern Plastics *36*, 164-165 (Nov. 1958).
332. "Plastics make portable washer possible," Modern Plastics *35*, 105-107, 234 (May 1958).
333. "Small parts: big savings," Modern Plastics *35*, 98-99 (Apr. 1958).
334. "Plastic chain coupling eliminates lubrication," Design News *13*, 22-23 (Mar. 31, 1958).
335. "Nylon-clad sleeve bearings," S. I. Penney and F. J. Bockhoff, Product Eng. *29*, 52-54 (Mar. 3, 1958).
336. "Sprayer body: 66% lighter," Modern Plastics *35*, 101 (Feb. 1958).
337. "Nylon film," by S. A. Zerbe, Modern Packaging *31*, 226-229, 314, 316 (May 1958).
338. "New jobs for nylon tubing," Modern Plastics *36*, 102-104 (Sept. 1958).
339. "Additives strengthen sintered nylon," by L. W. Alexander, Product Eng. *29*, 86-87 (Sept. 15, 1958).
340. "Nylon, asbestos team up," Chem. Eng. News *36*, 62, 64 (Sept. 8, 1958).
341. "Designing with nylon," by W. C. Warriner and A. J. Cheney, Product Eng. Design Digest, C11-C15 (Mid-Oct. 1957).
342. "Shape extrusion studies on nylon resin," by K. G. Toll, SPE J. *13*, 17-21 (July 1957).
343. "Dynamic mechanical properties of nylon 66 and the plasticising effect of water vapor on nylon," by J. M. R. Quistwater and B. A. Dunnell, Jr., J. Polymer Sci. *28*, 309-318 (Mar. 1958).
344. "On the stress relaxation of nylon 6," by T. Yoshitomi, K. Nagamatsu, and K. Kosiyama, J. Polymer Sci. *27*, 335-347 (Jan. 1958).
345. "Dynamic mechanical behavior of some nylons," by A. E. Woodward, J. A. Sauer, C. W. Deeley, and D. E. Kline, J. Colloid Sci. *12*, 363-377 (Aug. 1957).
346. "Static friction of bulk polymers over a temperature range," by B. L. Rua, Research (London) *10*, 331-332 (1957).
347. "Pyrolysis of polyamides," by S.

Straus, and L. A. Wall, J. Research NBS *60*, 39-45 (Jan. 1958).

348. "Quality control and some aging characteristics of nylon," by S. R. Prosen, SPE J. *13*, 28-31 (Dec. 1957).

349. "Melting points and heats of fusion of some polyamides and polyesters," by P. J. Flory, H. D. Bedon, and E. H. Keefer, J. Polymer Sci. *28*, 151-161 (Feb. 1958).

350. "On the viscometry of poly-6-caproamide," by F. Rybnikar, J. Polymer Sci. *29*, 519-530 (June 1958).

351. "A new polyester film in the limelight," Modern Plastics *35*, 94-97, 216-218 (Mar. 1958).

352. "Air-supported factory," Modern Plastics *36*, 173 (Nov. 1958).

353. "Where to use poyester film," by M. W. Riley, Materials in Design Eng. *46*, 104-109 (Sept. 1957).

354. "Photosensitive plastics—will they revolutionize photography?" by B. Schwalberg and G. Gaines, Popular Photography *43*, 108-111, 118 (July 1957).

355. "Structure of drawn polyethylene terephthalate," by W. J. Dulmage and A. L. Geddes, J. Polymer Sci. *31*, 499-512 (Sept. 1958).

356. "Industrial applications of 'Terylene' polyester fiber," by J. R. A. Kennedy, Plastics Inst. Trans. and J. *25*, 191-216 (July 1957).

357. "Vinyltoluene for polyester premix putties," by R. F. Helmreich, Modern Plastics *35*, 168, 170 (June 1958).

358. "Properties of polyesters of bisphenols and dicarboxylic acids," by M. Levine and S. C. Temin, J. Polymer Sci. *28*, 179-184 (Feb. 1958).

359. "Polymerization of triallyl cyanurate," by B. H. Clampitt, D. E. German, and J. R. Galli, J. Polymer Sci. *27*, 512-522 (Jan. 1958).

360. "2-Methyl-5-vinylpyridine in polyester resin formulations," by C. E. Wheelock, Ind. Eng. Chem. *49*, 1929-1930 (Nov. 1957).

361. "Modified resins from G. E.," Chem. Eng. News *36*, 56 (Aug. 11, 1958).

362. "The case for alkyds as electrical insulation," by N. Parkman, Brit. Plastics *30*, 483-485 (Nov. 1957).

363. "Alkyd moldings for electrical uses," by J. T. Long, Materials in Design Eng. *46*, 134-136 (Oct. 1957).

364. "A survey of some curing methods of polyester resins," by J. W. Cywinski, Brit. Plastics *30*, 449-454 (Oct. 1957).

365. "Thermal stability of resins. Infrared spectroscopic study of isomeric phthalic alkyds and silicone," by A. L. Smith, L. H. Brown, L. J. Tyler, and M. J. Hunter, Ind. Eng. Chem. *49*, 1903-1906 (Nov. 1957).

366. "Adhesion of polyester resin to treated glass surfaces," by N. M. Trivisonno, L. H. Lee and S. M. Skinner, Ind. Eng. Chem. *50*, 912-917 (June 1958).

367. "Determination of maleic anhydrides in polyesters," by P. D. Garn and H. M. Gilroy, Analytical Chem. *30*, 1663-1665 (Oct. 1958).

368. "Detection of phthalic acid isomers and benzoic acid in alkyd resins by infrared absorption spectrometry," by M. L. Adams and M. H. Swann, Analytical Chem. *30*, 1322-1324 (Aug. 1958).

369. "Assignment of infra-red absorptions and rotations in polyethylene terephthalate and related compounds," by D. Grime and I. M. Ward, Trans. Faraday Soc. *54*, 959-971 (July 1958).

370. "Spectrophotometric determination of phosphorus in polyethylene terephthalate," by Telep and Ehrlich, Analytical Chem. *30*, 1146-1148 (June 1958).

371. "Measurement of hydroxyl and carboxyl end groups in polyethylene terephthalate," by I. M. Ward, Trans. Faraday Soc. *53*, 14-6-1412 (Nov. 1957).

372. "Infra-red spectra of polyethylene terephthalates," by M. C. Tobin, J. Phys. Chem. *61*, 1392-1400 (Oct. 1957).

373. "Styrenes dodge dust," Chem. Eng. News *36*, 58 (Sept. 8, 1958).

374. "Styrene monomers—safety in handling and storage," by R. F. Helmreich, SPE J. *13*, 22-24 (July 1957).

375. "Manufacturers of polystyrene battery containers," by D. Day and M. Fuzzard, Rubber and Plastics Age *39*, 491, 493-494 (June 1958).

376. "New styrene plastics lighting fixtures," by R. A. McCarthy, Plastics Tech. *4*, 640-643 (July 1958).

377. "Records sound sweet to chemical makers," Chem. Week *83*, 96 (July 12, 1958).

378. "End-use correlation of styrene container testing," by B. Nathanson, Plastics Tech. *4*, 433-438 (May 1958).

379. "Chromatography of amino acids on sulfonated polystyrene resins; an improved system," by S. Moore, D. H. Spackman, and W. H. Stein, Analytical Chem. *30*, 1185-1190 (July 1958).

380. "Chromatographic adsorption of polystyrene," by S. J. Yeh and H. L. Frisch, J. Polymer Sci. *27*, 149-166 (Jan. 1958).

381. "New copolymer dinnerware," Modern Plastics *35*, 126-127, 232 (June 1958).

382. "ABS joins the artillery," Modern Plastics *35*, 96-97 (Feb. 1958).

383. "ABS grass catcher," Modern Plastics *36*, 105 (Sept. 1958).

384. "Thermoformed junior DeSoto," Modern Plastics *35*, 108-109 (May 1958).

385. "A strong case for plastics," Modern Plastics *35*, 100-101 (Apr. 1958).

386. "Toughened polystyrenes," by P. Brown, Plastics Inst. Trans. *26*, 137-149 (Apr. 1958).

387. "Cycolac in rigid thermoplastic piping," by H. H. Irvin and R. K. Multer, Plastics Tech. *3*, 892-898 (Nov. 1957).

388. "Polymerization of *p*-isopropenylstyrene," by P. Dreyfuss and N. T. Notley, J. Polymer Sci. *28*, 611-613 (Apr. 1958).

389. "Anionic polymerization of α-methylstyrene," by J. Worsfold and S. Bywater, J. Polymer Sci. *26*, 299-304 (Dec. 1957).

390. "Ionic polymerization. Copolymerization of nuclear and side-chain alkyl-substituted styrene monomers," by C. G. Overberger, D. Tanner, and E. M. Pearce, J. Am. Chem. Soc. *80*, 4566-4568 (Sept. 5, 1958).

391. "Anionic polymerization of α-methylstyrene. Kinetics," by D. J. Worsfold and S. Bywater, Canadian J. Chem. *36*, 1141-1145 (Aug. 1958).

392. "Pyrolysis of poly-α-methylstyrene," by D. W. Brown and L. A. Wall, J. Phys. Chem. *62*, 848-852 (July 1958).

393. "Oxidative degradation of a series of deuterated styrene polymers," by M. Tryon and L. A. Wall, J. Phys. Chem. *62*, 697-700 (June 1958).

394. "Degradation of addition polymers by ultrasonic waves," by M. A. K. Mostafa, J. Polymer Sci. *28*, 499-536 (Apr. 1958).

395. "Engineering aspects for polystyrene," by P. H. Estes,III. Plastics Tech. *4*, 644-651 (July 1958).

396. "Molecular polarizability. The spe-

fic Kerr constants and polarizations of various polystyrenes dissolved in carbon tetrachloride," by G. LeFevre, R. J. W. LeFevre, and G. M. Parkins, J. Chem. Soc. *1958*, 1468-1474 (Apr.).

397. "Infra-red spectra of high polymers. VI. Polystyrene," by C. Y. Liang and S. Krimm, J. Polymer Sci. *27*, 241-254 (Jan. 1958).

398. "Dynamic viscosity and shear modulus of molten polystyrene as a function of molecular weight," by W. P. Cox, L. E. Nielsen, and R. Keeney, J. Polymer Sci. *26*, 365-374 (Dec. 1957).

399. "Rigid vinyl-present and future," by G. A. Fowles and W. E. Manring. Modern Plastics *36*, 106-109, 211-212 (Dec. 1958).

400. "Fine future for plastisol-coated metal sheets," Modern Plastics, *36*, 96-98, 202 (Sept. 1958).

401. "Vinyl-metal laminates—up 1800% in two years," by V. Bartelmo Modern Plastics *35*, 102-105, 209-210 (Apr. 1958).

402. "Transparent vinyl wall," Modern Plastics *35*, 88 (July 1958).

403. "They cover a lot of ground." Modern Plastics *36*, 105-108, 207 (Oct. 1958).

404. "Erratic performance of Type 1 unplasticized polyvinyl chloride in 93% sulfuric acid pipelines," by H. E. Atkinson, Jr., and R. F. Degnan, Corrosion *14*, 261-262 (June 1958).

405. "How to work with rigid PVC plastic piping," by J. P. Kelleher and C. L. Mantell, Chem. Eng. *12*, 300, 302, 304, 308 (Dec. 1957).

406. "Plastics vie with metals," by J. P. Kelleher and C. L. Mantell, Chem. Eng. *11*, 296, 298, 300, 302, 304 (Nov. 1957).

407. "Pioneering the 'instant' emulsion market," Chem. Week *83*, 53, 56 (July 12, 1958).

408. "Polyvinyl chloride tape in corrosion mitigation program," by A. C. Kilberg, Corrosion Tech. 5, 10-12 (Jan. 1958).

409. "Applications for polyvinyl alcohol in the paper industry," by D. F. Lowry, Paper Trade J. *141*, 26, 28, (Dec. 23, 1957).

410. "PVA film goes commercial," Chem. Week *81*, 34-35 (Sept. 14, 1957).

411. "New fire-resistant mine belting," by D. D. Marshall, Rubber and Plastics Age *39*, 507 (June 1958).

412. "Vinyl protective glove," Modern Plastics *36*, 308 (Nov. 1958).

413. "New approach to drainage." Modern Plastics *36*, 161-163 (Nov. 1958).

414. "Silver peroxide-zinc alkaline cell. Polymeric membrane separators," by H. H. Bieber, P. F. Bruins, and H. P. Gregor, Ind. Eng. Chem. *50*, 1273-1278 (Sept. 1958).

415. "Modern 'stained glass' windows," Modern Plastics 35, 162 (July 1958).

416. "Polyvinyl chloride—new high-level dosimeter," by C. Artandi and A. A. Sonehill, Nucleonics *16*, 118, 120 (May 1958).

417. "Effect of small quantities of plasticizer in PVC compounds," by P. Ghersa, Modern Plastics *36*, 135-136, 139-140, 142, 212 (Oct. 1958).

418. "Effects of plasticizers on the fusion of vinyl plastisols," by L. A. McKenna, Modern Plastics *35*, 142-145, 148, 150-152, 234 (June 1958).

419. "The influence of formulation on the processing of PVC compositions," by R. Hammond, Plastics Inst. Trans. *26*, 49-68 (Jan. 1958).

420. "Dustless PVC eases processing," by R. S. Holdsworth, W. M. Smith, and J. T. Barry, Modern Plastics *35*, 131-133, 136, 138 (June 1958).

421. "Hot subject: heat sealing," Modern Plastics, *35*, 85-90, 204, 207 (Apr. 1958).

422. "Causes and control of calender roll plating of vinyl compounds," by L. G. Howard and R. C. Hess, Plastics Tech. *3*, 887-891, 911 (Nov. 1957).

423. "PVC dry blend extrusion," by E. H. Hankey and R. D. Sackett, SPE J. *14*, 43-48, 72 (Mar. 1958).

424. "Coating, printing, embossing," MPL, *35*, 116-117, 120-121 (Apr. 1958).

425. "Creep and stress-rupture behavior of rigid PVC pipe, I," by J. H. Faupel, Modern Plastics 35, 120, 122, 125-126, 128, 188 (July); "II." ibid. 132, 134, 136, 139, 202 (Aug. 1958).

426. "Measurement of PVC brittle point," by H. O. Williams, Brit. Plastics *31*, 107-111 (Mar. 1958).

427. "Heat and ultra-violet aging of polyvinyl chloride," by C. F. Bersch, M. R. Harvey, and B. G. Achhammer, J. Research NBS *60*, 481-488 (May 1958).

428. "Structure and mechanism of dehydrochlorination of polyvinyl chloride," by B. Baum and L. H. Wartman, J. Polymer Sci. *28*, 537-546 (Apr. 1958).

429. "Infra-red spectra of thermally degraded polyvinyl chloride," by R. R. Stromberg, S. Straus, and B. G. Achhammer, J. Research NBS *60*, 147-152 (Feb. 1958).

430. "Infra-red spectra of reduction products from poly(vinyl chloride)," by M. H. George, R. J. Grisenthwaite, and R. F. Hunter, Chem. and Ind. No. 34, 1114 (Aug. 23, 1958).

431. "Diffusion of allyl chloride in polyvinyl acetate," by P. Meares, J. Polymer Sci. *27*, 391-418 (Jan. 1958).

432. "Solubilities of gases in polyvinyl acetate," by P. Meares, Trans. Faraday Soc. *54*, 40-46 (Jan. 1958).

433. "Water vapor diffusion through vinyl chloride-vinyl acetate copolymers," by C. A. Kumins, C. J. Rolle, and J. Roteman, J. Phys. Chem. *61*, 1290-1296 (Oct. 1957).

434. The heat of polymerization of vinyl acetate," by W. I. Bengough, Trans. Faraday Soc. *54*, 54-59 (Jan. 1958).

435. "Adsorption of polyvinyl acetate," by J. Koral, R. Ullman, and F. R. Eirich, J. Phys. Chem. *62*, 541-550 (May 1958).

436. "X-ray diffraction pattern of a vinylidene cyanide/vinyl acetate copolymer," by J. A. Yanko, A. Hawthorne, and J. W. Born, J. Polymer Sci. *27*, 145-157 (Jan. 1958).

437. "Molecular weight of polyvinyl acetate," by A. F. Sirianni, R. Trembley, and I. E. Puddington, Canadian J. Chem. *36*, 543-549 (Mar. 1958).

438. "Preparation of polymers and copolymers from vinylpyrimidines and triazines," by C. G. Overberger and F. W. Michelotti, J. Am. Chem. Soc. *80*, 988-991 (Feb. 20, 1958).

439. "Kinetics of polymerization of vinylene carbonate," by G. Smets and K. Hayashi, J. Polymer Sci. 29, 257-274 (May 1958).

440. "Copolymerization of vinylene carbonate with vinyl thiolacetate and N, N, N-triethyl-N-[2-(methacryloxy) ethyl] ammonium iodide with 4-vinylpyridine," by C. G. Overberger, H. Biletch, and R. G. Nickerson, J. Polymer Sci. 27, 381-390 (Jan. 1958).

441. "Copolymerizarion of vinylene carbonate," by K. Hayashe and G. Smets, J. Polymer Sci. 27, 275-283 (Jan. 1958). Sci. 29, 629-36 (June 1958).

442. "A new method of synthesis of

polyvinylamine," by R. Hart, J. Polymer Sci. 29, 629-36 (June 1958.
443. "Polymerization of vinyl stearates by high energy electrodes," by W. Burlant and A. Adicoff, J. Polymer Sci. 27, 269-274 (Jan. 1958).
444. "Synthesis of branched chain polyvinyl acetates," by H. W. Melville, F. W. Peaker, and R. L. Vale, J. Polymer Sci. 30, 29-30 (July 1958).
445. "Vinyl acetate emulsion polymerization," by J. T. O'Donnell, R. B. Mesrobian, and A. E. Woodward, J. Polymer Sci. 28, 171-177 (Feb. 1958).
446. "Reactions of phosphoric acid with polyvinyl acetals" by R. A. Barnes, J. Polymer Sci. 27, 285-294 (Jan. 1958).
447. "Copolymerization of trialkyl aconitates with vinylidene chloride," by C. S. Marvel and E. B. Mano, Journal of Polymer Science 31, 165-171 (Aug. 1958).
448. "Validity of the theory of gelation in vinyl-divinyl copolymerization," by L. Minnema and A. J. Staverman, J. Polymer Sci. 29, 281-306 (May 1958).
449. "Reactivity ratio of vinyl esters of aliphatic and some common vinyl monomers," by C. S. Marvel and W. G. DePierri, J. Polymer Sci. 27, 39-58 (Jan. 1958).
450. "Advances in ionic polymerization of vinyl-type monomer," by C. E. Schildknecht, Ind. Eng. Chem. 50, 107-114 (Jan. 1958).
451. "Determination of lead in polyvinyl chloride compositions containing lead stabilizers," by S. Grossman and J. Haslam, J. Applied Chem. 7, 639-644 (Nov. 1957).
452. "First polycarbonate applications," Modern Plastics 36, 96-97 (Dec. 1958).
453. "Polycarbonate resin," by W. F. Christopher, SPE J. 14, 31-34 (June 1958).
454. "Polycarbonate resin," by R. J. Thompson and K. B. Goldblum, Modern Plastics 35, 131-132, 134-136, 138, 218, 221 (Apr. 1958).
455. "Polycarbonate resins," by R. J. Thompson and K. B. Goldblum, Plastics (London) 23, 122-125 (Apr. 1958).
456. "Polycarbonates," Brit. Plastics 31, 112-114 (Mar. 1958).
457. "Polyox: Polymerization with alkaline earth carbonate catalysts," by F. N. Hill, F. E. Bailey, and J. T. Fitzpatrick, Ind. Eng. Chem. 50, 5-7 (Jan. 1958).
458. "Polyox: Solution properties," by F. E. Bailey, Jr., G. M. Powell and K. L. Smith, Ind. Eng. Chem. 50, 8-11 (Jan. 1958).
459. "Polyox: High molecular weight polymers of ethylene oxide," by K. L. Smith and R. Van Cleve, Ind. Eng. Chem. 50, 12-16 (Jan. 1958).
460. "Aromatic polyanhydrides, a new class of high fiber-forming polymers," by A. Conix, J. Polymer Sci. 29, 343-353 (June 1958).
461. "Why not wood-flour-filled urea?" Modern Plastics 35, 115-117 (May 1958).
462. "Analysis of amino-formaldehyde resins," by J. C. Morath and J. T. Woods, Analytical Chem. 30, 143-150 (Aug. 1958).
463. "Detection of urea, melamine, isocyanate, and urethane resins," by M. H. Swann and G. G. Esposito, Analytical Chem. 30, 107-109 (Jan. 1958).
464 "Determination of melamine-formaldehyde resins in coatings," by M. H. Swann and G. G. Esposito, Analytical Chem. 29, 1361-1362 (Sept. 1957).
465. "Inhibition of resin acid isomerization," by Loeblich and Lawrence, Ind. Eng. Chem. 50, 619-620 (Apr. 1958).
466. "Linear polyesters derived from protocatechuic acid," by L. H. Bock and J. K. Anderson, J. Polymer Sci. 28, 121-127 (Feb. 1958).
467. "An infra-red absorption method for measuring phase transitions of waxes," by J. M. Martin, Jr., R. W. B. Johnston, H. J. Cannon, and M. J. O'Neal, Analytical Chem. 30, 1005-1006 (May 1958).
468. "Inexpensive seals for prototype molds," Modern Plastics 36, 192 (Sept. 1958).
469. "Curing of silicone rubber," by C. J. Baker and I. H. Riley, Rubber and Plastics Age 39, 577, 579-580 (July 1958).
470. "Crystallinity and orientation in silicone rubber. I. X-ray studies," by S. M. Ohlberg, L. E. Alexander, and E. L. Warrick, J. Polymer Sci. 27, 1-17; "II. Physical measurements," by E. L. Warrick, ibid. 27, 19-38 (Jan. 1958).
471. "Silicone rubber as a selective barrier. Gas and vapor transfer," by K. Kammermeyer, Ind. Eng. Chem. 49, 1685-1686 (Oct. 1957).
472. "Thermal and oxidative degradation of silicones," by L. C. Scala and W. M. Hickam, Ind. Eng. Chem. 50, 1583-1584 (Oct. 1958).
473. "Logarithmic thermal degradation of a silicone resin in air," C. D. Doyle, J. Polymer Sci. 31, 95-104 (Aug. 1958).
474. "Resin sales reflect the silicone surge," Chem. Week 83, 85-86, 88 (July 1958).
475. "Elastomers," by B. S. Garvey, Jr., Ind. Eng. Chem. 50, 1438-1443 (Sept. 1958).
476. "High-speed fracture in rubber," by P. Mason, J. Applied Phys. 29, 1146-1150 (Aug. 1958).
477. "Compounds for high temperature fuel seals," by E. J. Fujiwara, W. G. Smith, and R. G. Spain, Rubber Age 82, 1016-1020 (Mar. 1958).
478. "A comparison of instruments used to determine suitability of elastomers for low temperature service," by M. Hanok, J. Z. Lichtman, C. K. Chatten, and G. Adler, Rubber Age 82, 275-285 (Nov. 1957).
479. "Rubber and resin-rubber soling," Rubber and Plastics Age 38, 860 (Oct. 1957).
480. "The nature of the particle surface of Hevea latex and pastes of rubber hydrochloride and polyvinyl chloride," by G. Schuur, J. Colloid Sci. 12, 538-548 (Dec. 1957).
481. "Where to use Hypalon," by B. W. Fuller, Materials and Methods 45, 96-100 (Jan. 1957).
482. "Epoxidation of liquid polybutadiene," by C. E. Wheelock, Ind. Eng. Chem. 50, 299-304 (Mar. 1958).
483. "Perdeutero synthetic-natural rubber," by W. L. Semon and others, Science 128, 359 (Aug. 15, 1958).
484. "The stereochemistry and mechanism of reversible polymerization of 2,2-disubstituted 1,3-propanediol carbonates," by S. Sarel and L. A. Pohoryles, J. Am. Chem. Soc. 80, 4596-4599 (Sept. 5, 1958).
485. "Polymeric phthalocyanines," by C. S. Marvel and J. H. Rassweiler, J. Am. Chem. Soc. 80, 1197-1199 (Mar. 5, 1958).
486. "Kinetics of polymerization of nitroethylene. II. Study of molecular weights (by cryoscopic method)," by D. Vofsi and A. Katchalsky, J. Polymer Sci. 26, 127-139 (Nov. 1957).
487. Alpha, beta-unsaturated ketones.

II. Copolymerization reactions of trans-cinnamoylfrerocene," by L. E. Coleman, Jr. and M. D. Rausch, Journal of Polymer Science *28*, 207-211 (Feb. 1958).

488. "Polymeric derivatives of hydrazine," by R. F. Evans and J. I. Jones, Chem. and Ind. *1958*, 915 (July 19).

489. "Polymers from oxacyclobutanes. I. Synthesis and general properties," by A. C. Farthing, J. Applied Chem. *8*, 186-188; "II. The laboratory-scale evaluation of the polymer from 3:3-bischloromethyl-oxacyclobutane," by D. J. H. Sandiford, ibid. 188-196 (Mar. 1958).

490. "Formation of linear polymers from diene monomers by a cyclic polymerization mechanism. I. Structure of poly(diallyl-ammonium halides)," by G. B. Butler, A. Crawshaw, and W. L. Miller, J. Am. Chem. Soc. *80*, 3615-3618 (July 20, 1958).

491. "Synthesis of metal-complexing polymers. I. Phosphorylated polymers," by J. Kennedy, E. S. Lane, and B. K. Robinson, J. Applied Chem. *8*, 459-464; "II. Phosphonamide and alpha-amino-phosphonate polymers," by J. Kennedy and G. E. Ficken, ibid, 465-468 (July 1958).

492. "Some special features of organic polymers containing phosphorus," by V. V. Korshak, J. Polymer Sci. *31*, 319-326 (Sept. 1958).

493. "Synthesis of new polymers with inorganic chains of molecules," by K. A. Andrianov and A. A. Zhdanov, J. Polymer Sci. *30*, 513-524 (July 1958).

494. "Multicomponent polymers. I. Three-component systems," by R. J. Slocombe, J. Polymer Sci. 26, 9-22 (Oct. 1957).

495. "Engineering aspects of polymer processes. A symposium," Ind. Eng. Chem. 49, 1796-1862 (Nov. 1957).

496. "Statistical analysis in a polymerization process," by L. A. Pasteelnick and W. B. Leder, Chem. Eng. Progress *53*, 392-395 (Aug. 1957).

497. " 'Caged' accelerators," Chem. Eng. News 36, 62, 64 (May 26, 1958).

498. "Work with labeled initiators," by J. C. Bevington, J. Polymer Sci. 29, 235-243 (May 1958).

499. "Polymerization," by A. F. Roche and F. H. Bolton, Ind. Eng. Chem. 50, 1393-1400 (Sept. 1958).

500. "Recent advances in polymerization techniques, by H. Melville, Plastics Inst. Trans. *26*, 281-288 (July 1958).

501. "Properties of structural reinforced plastics," by Zeilberger and Lieb, Aviation Age *30*, 90 (Aug. 1958).

502. "Now—into the space age" Modern Plastics *35*, 105-110, 218-221 (June 1958).

503. "Behavior of reinforced plastics at very high temperatures," by I. J. Gruntfest and L. H. Shenker, Modern Plastics *35*, 155-156, 158, 160, 162-163, 166, 235-237 (June 1958).

504. "Reinforced plastics at 3,000° to 25,000° F," by M. W. Riley, Materials in Design Eng. *47*, 100-104 (June 1958).

505. "Heat-blast erosion effects on reinforced plastic laminates," by N. B. Miller and E. L. Strauss, SPE J. *14*, 37-40, 69 (Feb. 1958).

506. "Effect of temperature on industrial plastic laminates," by N. A. Skow, Materials in Design Eng. *47*, 109-111 (Feb. 1958).

507. "Heat-resistant laminate for supersonic equipment," by F. W. Jahns, Electrical Mfg. *61*, 84-85 (Jan. 1958).

508. "Transient heat flow studies aid design of reinforced plastic structures," by J. L. Dietz and W. L. Hangen, Aviation Age *28*, 76-82 (Nov. 1957).

509. "Controlled thermal-shock testing of glass-cloth laminates," by J. H. Beno, A. M. Dowell, and E. F. Smith, ASTM Bulletin No. 225, 25-28 (Oct. 1957).

510. "Glass-flake paper—a new electrical insulation material," by L. M. Conklin and M. P. Koerner, Electrical Mfg. *61*, 87-91 (June 1958).

511. "Versatile new reinforcing paper," Modern Plastics *35*, 164 (July 1958).

512. "How and why to use glass-reinforced injection molding compounds," by R. Bradt, Modern Plastics *35*, 100-102, 192, 194 (Mar. 1958).

513. "Premix scores in welding transformers," by P. E. Girton, Modern Plastics *36*, 110-111, 215 (Dec. 1958).

514. "Future of glass-reinforced plastics," by J. H. Collins, Plastics (London) *23*, 161-162 (May 1958).

515. "Fiber-reinforced plastics," by F. R. Park, Product Eng. *29*, 69-71 (Feb. 3, 1958).

516. "Laminates with inorganic fillers," by N. W. Knewstubb, Plastics Inst. Trans. *26*, 10-22 (Jan. 1958).

517. "Glass reinforcement for structural plastics," by R. G. Adams and R. Sonneborn, SPE J. *13*, 25-27, 79 (Dec. 1957).

518. "Reinforced plastics by 'sprayup'," Modern Plastics *35*, 119-21, 124 (Feb. 1958).

519. "Continuous forming of fibrous mat," by P. E. Fuerst, Modern Plastics *36*, 115-117, 120, 122, 209 (Oct. 1958).

520. "Automatic resin content control in high-pressure laminate manufacture," by H. R. Levine, Modern Plastics *35*, 133-136, 140, 142-143 (May 1958).

521. "Reinforced plastics preforming without discoloration," by R. E. Mollman, Plastics Tech. *4*, 636-639 (July 1958).

522. "Postformed phenolic laminates," by H. Storch, Product Eng. *29*, 66-68 (Feb. 17, 1958).

523. "Bladder molding forms smooth plastic laminates," by J. A. Bagley and F. M. Partridge, Am. Machinist *102*, 102-103 (Apr. 7, 1958).

524. "Plastics ahoy!" Modern Plastics *35*, 87-95, 210, 212, 215-216 (Feb. 1958).

525. "Plastics riding high," Chem. Eng. *36*, 72-77 (Aug. 25, 1958).

526. "Boat mold for mass-production," by F. M. Coleman, Modern Plastics *35*, 121-122 (Aug. 1958).

527. "Reinforced plastics in boat hull construction," by R. J. Della Rocca, Plastics Tech. *3*, 904-910, 992-995 (Nov., Dec. 1957).

528. "Reinforced plastics pipe progress," by H. D. Boggs, Modern Plastics *35*, 96-101, 189, 192 (Aug. 1958).

529. "Indestructible bus seats," Modern Plastics *35*, 94-96 (Apr. 1958).

530. "Less weight, more room in plastics van," Modern Plastics *35*, 179 (Mar. 1958).

531. "Torpedo launcher of reinforced plastics," Materials in Design Eng. *47*, 11 (Apr. 1958).

532. "Where plastics compete with concrete," Modern Plastics *35*, 102-103 (May 1958).

533. "Better cabinets for TV portables," Modern Plastics *36*, 110-111 (Sept. 1958).

534. "Radar reflectors of reinforced plastic," by R. L. Mondano, Electronic Design *6*, 34-37 (May 28, 1958).

535. "Reinforced plastics filter plates benefit process industries," Modern Plastics *35*, 93 (Aug. 1958).

536. "New filter plates: plastics dis-

places metal," by C. C. Van Soye, Chem. Eng. 65, 68, 74 (June 30, 1958).

537. "'Laminate art'—new mural design," MPL. 35, 92-93, 172 (July 1958).

538. "Plastics cut costs in machine tools," by E. Quastler, Modern Plastics 35, 110-111 (May 1958).

539. "Reinforced plastics-foil roofing panel," Modern Plastics 36, 194 (Sept. 1958).

540. "Flame-retardant translucent panels," Rubber and Plastics Age 39, 219-221 (Mar. 1958).

541. "Translucent plastic glazing in industry," The Plant 16, 44-49 (Nov. 1957).

542. "Build or repair with epoxy-glass laminates," by T. G. Nock and R. A. Codene," Chem. Eng. 65, 148, 150, 152 (Jan. 27, 1958).

543. "Reinforced plastic protective coatings," by E. A. Morgenstern and M. Stander, BuShips J. 7, 13-17 (June 1958).

544. "Conveyor assembly trays speed materials handling," Modern Plastics 36, 183 (Dec. 1958).

545. "Where labor costs count," Modern Plastics 36, 154-155 (Nov. 1958).

546. "Kaolinite fractions, their effect on physical properties of reinforced plastics," by G. P. Larson, Modern Plastics 35, 157-158, 160, 162, 165-166, 236-237 (May 1958).

547. "Effects of molding pressure on glass-fiber reinforced plastics," by S. D. Toner, I. Wolock, and F. W. Reinhart, SPE J. 14, 40-45 (June 1958).

548. "Contribution of glass fiber wetting to the properties of glass reinforced polyester systems," by V. G. Sonkup and F. H. Batton, Reinforced Plastics 2, 11-17 No. 6 (1958).

549. "Molding-finish interactions in fatigue of glass-reinforced polyester resins," by R. C. Hooper, Plastics Tech. 3, 644-649 (Aug. 1957).

550. "Effect of lay-up configuration on flexural properties of 181 glass cloth laminates," by W. R. McGlone, SPE J. 13, 30-34 (Oct. 1957).

551. "Influence of resin and process variables on polyester-glass laminate properties," by A. L. Smith and W. G. Carson, Plastics Tech. 4, 805-811, 840 (Sept. 1958).

552. "Physical properties of prepreg laminates," by G. Brown, Plastics Tech. 4, 631-635 (July 1958).

553. "Importance of fabrication on the properties of silicone-glass laminates," by E. C. Elliot and K. R. Hoffman, Plastics Tech. 4, 235-239 (Mar. 1958).

554. "Fatigue properties of reinforced plastics," Materials in Design Eng. 46, 108-111 (July 1957).

555. "Flexural fatigue strengths of reinforced thermosetting laminates," by B. B. Pusey, Plastics Tech. 3, 721-727 (Sept. 1957).

556. "Creep of glass-reinforced plastics," by S. Goldfein, ASTM Bulletin No. 225 29-36 (Oct. 1957).

557. "Long-term rupture and impact stresses in reinforced plastics," by S. Goldfein, ASTM Bulletin No. 224, 36-39, (Sept. 1957).

558. "Screw-holding power of polyester laminates," by R. R. Dixon, Product Eng. Design Digest G22-G24 (Mid-Oct. 1957).

559. "Surface erosion of filled plastics," by S. B. Newman, S. D. Toner, and B. G. Achhammer, Modern Plastics 36, 135-136, 138, 140-141, 144-146, 148, 150, 216, 218 (Dec. 1958).

560. "Significance of second-order transitions of polyester and epoxy resins in glass fiber-reinforced laminates," by A. D. Coggeshall, Plastics Tech. 4, 51-59 (Jan. 1958).

561. "Resistance of glass fiber reinforced laminates to weathering," by L. Gilman, SPE J. 13, 33-38 (Nov. 1957).

562. "Rapid determination of moisture capacity, diffusion coefficient, and activation energy in plastics laminates," by J. W. Rowen and R. K. Laudenslager, Modern Plastics 36, 222-224 (Nov. 1958).

563. "The biological action of fiberglas-plastic dust," by G. W. H. Schepers and others, Archives and Industrial Health 18, 34-37 (July 1958).

564. "Plastics to boom in building," Chem. Eng. News 36, 26-27 (June 16, 1958).

565. "Rigid plastics foams in building," by A. G. H. Dietz, Modern Plastics 36, 91-94, 187-191 (Dec. 1958).

566. "Designing stiffness into plastics structures," by S. Levy, Modern Plastics 36, 123, 126, 128, 130, 132, 212 (Sept. 1958).

567. "Thermoplastic foams as thermal insulation in roofs," by R. N. Kennedy, Rubber and Plastics Age 39, 592-594 (July 1958).

568. "Sandwich panel adhesives," by R. K. Humke, Product Eng. 29, 56-60 (May 26, 1958).

569. "Designer's guide to honeycomb-sandwich structures," by A. Marshall, Machine Design 30, 126-135 (May 15, 1958).

570. "Sandwich-panel facing materials," by R. K. Humke, Product Eng. (Design Ed.) 29, 80-83 (Apr. 28, 1958).

571. "Selection guide for sandwich-panel core materials," by R. K. Humke, Product Eng. 29, 70-75 (Jan. 20, 1958).

572. "Recent developments in the use of rigid low-density materials in plastics structures," by D. S. Mahon, Plastics Inst. Trans. 26, 69-79 (Jan. 1958).

573. "Foam package protects missile data," Modern Plastics 36, 184-185 (Dec. 1958).

574. "Styrene foam and reinforced plastics in tracking dome," Modern Plastics 35, 104-105 (Aug. 1958).

575. "Plastics and ceramic foams for electronic applications," by W. R. Cumin and P. M. Andress, Electrical Mfg. 61, 100-104 (May 1958).

576. "Measurement and interpretation of properties of low-density plastics," by G. C. Ives, Plastics Inst. Trans. 26, 208-24 (July 1958).

577. "Properties of cellular polymers," by A. Cooper, Plastics Inst. Trans. 26, 299-330 (July 1958).

578. "Electronic pendulum for evaluating impact absorption of foam materials," by C. S. Wilkinson, Jr., Rubber World 136, 841-846, 851 (Sept. 1957).

579. "Cellular vinyl foams," by W. G. McLain, SPE J. 13, 41-44 (July 1957).

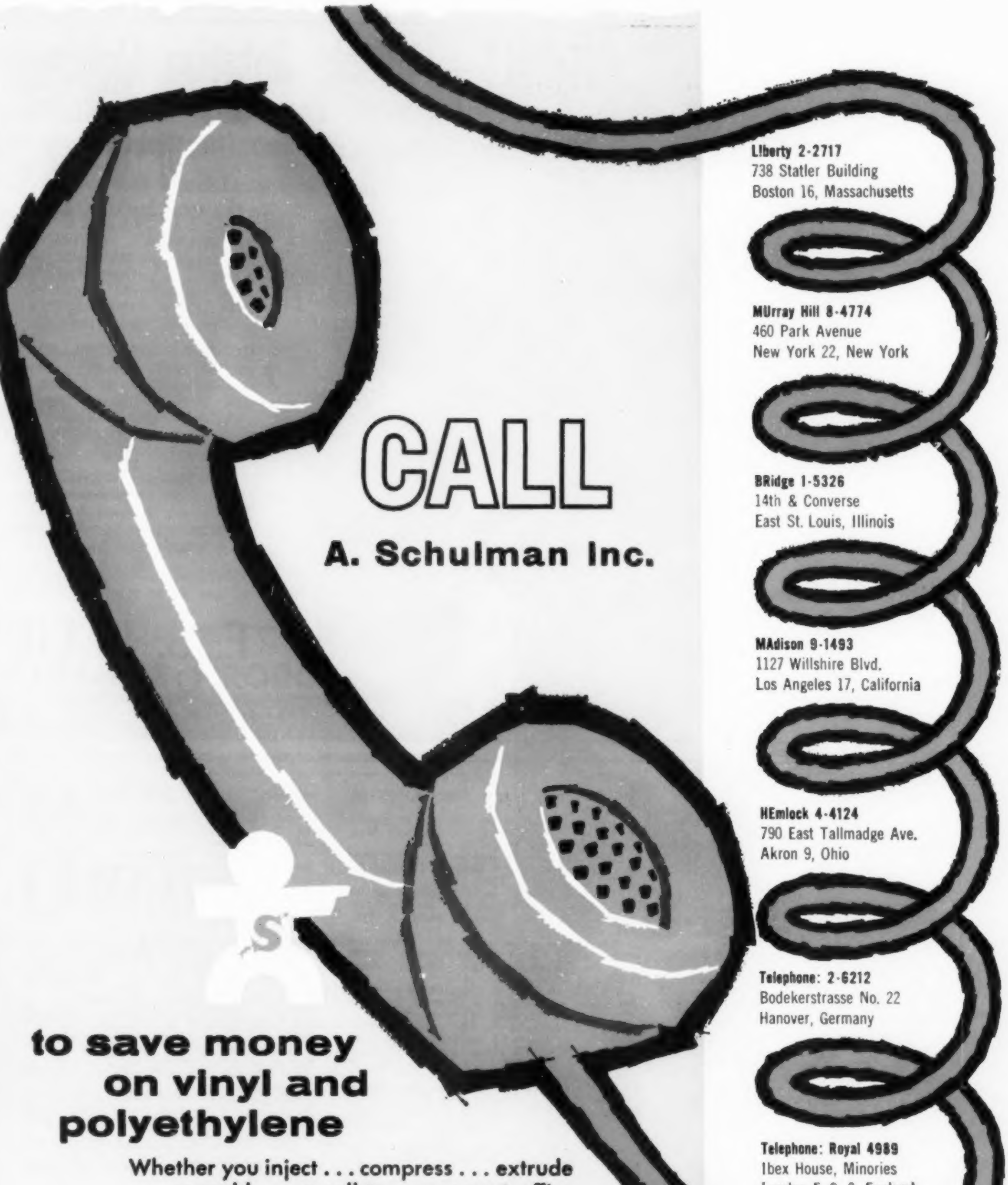
580. "Properties and characteristics of foamed plastic materials," by H. J. Stark, Product Eng. 28, 166-170 (Apr. 1957).

581. "A new apparatus for determining the cell structure of cellular materials," by W. J. Remington and R. Pariser, Rubber World 138, 261-264 (May 1958).

582. "Plasticizer production and sales, 1957," by P. W. Spink and W. F. Waychoff, MPL. 36, 182-188 (Sept. 1958).

583. "Epoxy esters. Relationship of structure to plasticizer performance," by R. M. Brice and W. M. Budde, Ind. Eng. Chem. 50, 868-870 (June 1958).

584. "Derivatives of cyclohexene oxide



as plasticizers and stabilizers for vinyl chloride resins," by R. van Cleve and D. H. Mullins, Ind. Eng. Chem. *50*, 873-876 (June 1958).

585. "Some *n*-disubstituted amides of long-chain fatty acids as vinyl plasticizers," by F. C. Magne, R. R. Mod, and E. L. Skau, Ind. Eng. Chem. *50*, 617-618 (Apr. 1958).

586. "Some aspects of the stabilization of vinyl insulation," by J. G. Henricks and N. L. Cooperman, Plastics Tech. *4*, 127-131 (Feb. 1958).

587. "Toxicity of plastics," Brit. Plastics *31*, 115 (Mar. 1958).

588. "Identification of mixed plasticizers by a combination of chromatography and infra-red spectroscopy," by M. Cachia, D. W. Southwart, and W. H. T. Davison. J. Applied Chem. *8*, 291-293 (May 1958).

589. "At war with the sun," Chem. Eng. News *35*, 52 (Oct. 28, 1957).

590. "Preparation and properties of the alkylene carbonates," by W. J. Peppel, Ind. Eng. Chem. *50*, 767-770 (May 1958).

591. "Color," Rubber and Plastics Age *39*, 470-471 (July 1958).

592. "Pigments in polymer materials," by J. F. Ambrose, Brit. Plastics *30*, 446-447 (Oct. 1957).

593. "Colorants for plastics," by S. Bonnie, Jr. Plastics Tech. *3*, 633-638 (Aug. 1957).

Processing

594. "Valve gating of injection molds," by A. Spaak and G. Kelly, Modern Plastics *36*, 117-120, 122 (Sept. 1958).

595. "Good design," by J. Rowan, Canadian Plastics *1958*, 34-35, 39-40 (July).

596. "Some aspects of extrusion die design," by E. G. Fisher and W. A. Maslem, Brit. Plastics *31*, 276-281 (July 1958).

597. "Effective mold design," by C. F. Pearl, Modern Plastics *35*, 111-115 (Apr. 1958).

598. "Metal inserts for plastic molding," Product Eng. (Design Ed.) *29*, 104-105 (Apr. 28, 1958).

599. "Designing for injection molded plastics," by J. R. Kent, Materials in Design Eng. *46*, 106-111 (Dec. 1957).

600. "Designing for compression and transfer moldings," by J. E. Johnston, Materials in Design Eng. *46*, 126-131 (Nov. 1957).

601. "How to design cost out of plastic parts," by R. L. Daggett, Product Eng. *28*, 77-79 (Oct. 14, 1957).

602. "The dollar value of automated thermoset molding," Modern Plastics *35*, 85-89, 182 (Aug. 1958).

603. "Automatic pellet deflashing of moldings with metal-pin inserts," by E. F. Anderson, Plastics Tech. *3*, 714-715, 720 (Sept. 1957).

604. "Plant planned for automatic molding," by L. A. Ulmschneider," Modern Plastics *35*, 120-124, 229-231 (June 1958).

605. "Economics of unscrewing molds," by I. Thomas and E. J. Csaszar, Modern Plastics *36*, 181-183, 186 (Nov. 1958).

606. "Automated extrusion-thermoforming is used to produce large and intricate formed sheet pieces at high speeds," Modern Plastics *35*, 101-107, 218 (Feb. 1958).

607. "Custom molders at the crossroads," MPL. *36*, 87-90, 186 (Dec. 1958).

608. "Auxiliary equipment saves money for molder," by M. Bloom, Canadian Plastics *1938*, 38-39, 45 (Aug.).

609. "Capacitative heating of dielectrics in h.-f. fields," Plastics (London) *23*, 250, 267 (July 1958).

610. "Testing thermosetting molding materials for moldability," by J. T. Nye, Plastics Inst. Trans. *26*, 82-100 (Apr. 1958).

611. "Molding shrinkage and related effects in a fixed cavity compression mold. Part 1," by W. R. McGlone and L. B. Keller. Modern Plastics *35*, 125-126, 128, 130, 132, 135-136, 219-220 (Feb.); "Part 2," ibid. 117-120, 122, 189 (Mar. 1958).

612. "Sequential impact molding," by G. D. Gilmore and J. Decker, Modern Plastics *36*, 187, 188, 190, 192, 310, 312 (Nov. 1958).

613. "Injection molding machine drive," by F.R. Gloeckner, Modern Plastics *35*, 194, 196 (Nov. 1958).

614. "What a plastics engineer should look for when planning to buy an injection molding machine," by G. B. Thayer, Plastics Tech. *4*, 439-466 (May 1958).

615. "Heat generation and expansion effects in the rheology and molding of plastics," by H. L. Toor, SPE J. *14*, 27-30 (Jan. 1958).

616. "Hidden injection molding costs," by D. A. Dearle, Plastics Tech. *3*, 985-987 (Dec. 1957).

617. "Progress in extrusion," by E. C. Bernhardt, Modern Plastics *36*, 115-118, 120 (Dec. 1958).

618. "What a plastics engineer should look for when planning to buy an extrusion machine," by R. E. Monica, Plastics Tech. *4*, 817-830 (Sept. 1958).

619. "The engineering of extrusion," Brit. Plastics *31*, 27-275 (July 1958).

620. "Extrusion—a contemporary assessment," by A. Kennaway, Brit. Plastics *31*, 286-269 (July 1958).

621. "Experimental determination of velocity profiles in an extruder screw," by S. Echer and A. Valentionotti, Ind. Eng. Chem. *50*, 829-836 (May 1958).

622. "Some aids to the design of dies for plastics extrusion," by D. J. Weeks, Brit. Plastics *31*, 156-160 (Apr.); 201-205 (May 1958).

623. Screw-extruder pumping efficiency as influenced by relative channel depth and curvature," by P. H. Squires, SPE J. *14*, 24-30 (Apr. 1958).

624. "Recent developments in the extrusion of plastics," by G. L. Bata, Canadian J. Chem. Eng. *35*, 159-164 (Dec. 1957).

625. "No backing board," Modern Plastics *36*, 286 (Nov. 1958).

626. "Factors affecting the formability of etxruded sheet plastics," by E. L. Williams and T. R. Twitchett, Rubber and Plastics Age *39*, 575-576 (July 1958).

627. "Vacuum forming and its applications," by R. U. Harwood, Plastics (London) *23*, 248-250 (July 1958).

628. "Modern plastics machinery," by O. F. Bartoo, Plastics Inst. Trans. *26*, 251-276 (July 1958).

629. "Fabricating fiber glass mat reinforced plastics. Part I," by G. Bomberg, Insulation *4*, 14-18 (Apr.); "Part II," ibid. 9-14 (May 1958).

630. "Design of molds for reinforced plastics," by J. C. Reib, Plastics Tech *3*, 981-984 (Dec. 1957).

631. "How to machine laminated plastics," by T. R. Silk, Iron Age *181*, 77-80 (May 1); 106-109 (May 8); 82-85 (May 15, 1958).

632. "New developments and tech-

niques of sawing and machining glass reinforced plastics," L. H. Barron, Insulation 4, 14-17 (Jan. 1958).

633. "Calenders," by H. Kaiser, Rubber and Plastics Age 39, 485-489 (June 1958).

634. "Automatic film sealing," Rubber and Plastics Age 39, 295, 297 (Apr. 1958).

635. "Electronic heat-sealing," by R. D. Farkas, Modern Plastics 35, 109-111, 114, 116 (Mar. 1958).

636. "An improved laboratory heat-sealer," by K. W. Ninnemann, Modern Packaging 31, 171-175, 250, 252 (Nov. 1957).

637. "Processing systems for optimum design use of casting resins," by W. A. Gammel, Sr., Electrical Mfg. 62, 80-83 (Sept. 1958).

638. "Internal strains in casting resins," by R. N. Sampson and J. B. Lesnick, SPE J. 14, 33-35 (Aug. 1958).

639. "Measurement of stresses in cast resins," by A. J. Bush, Modern Plastics 35, 143-144, 148, 224 (Feb. 1958).

640. "Embedment, potting, and encapsulating processes," by C. A. Harper, Plastics Tech. 3, 814-818 (Oct. 1957).

641. "Short-run plastics parts cast in rubber molds," by I. R. Axelrad, Materials and Methods 45, 104-105 (Feb. 1957).

642. "Coating methods," by G. L. Booth, Modern Plastics 36, 91-95 (Sept.); 90-99 (Oct. 1958).

643. "Repairing molds by eelctroforming," by W. J. B. Stokes, II., Modern Plastics 36, 121-122, 124, 126 (Dec. 1958).

644. "Intensive mixing," by W. R. Bolen and R. E. Colwell, SPE J. 14, 24-28 (Aug. 1958).

645. "Miniature intensive mixer," by M. S. Sheftel and G. E. Berlyn, Modern Plastics 35, 140, 233 (June 1958).

646. "Continuous compounding of thermoplastics," by D. Grant, Rubber and Plastics Age 39, 481-484 (June 1958).

647. "Dry coloring for injection molding," Plastics Tech. 4, 447 (May 1958).

648. "Moisture, monster of metallizing, meets end in trap," by J. A. Selemeyer and H. M. Farrow, Modern Plastics 35, 109, 180 (July 1958).

649. "Labelling rubber and plastics," by F. T. Day, Rubber and Plastics Age 39, 587 (July 1958).

650. "Marking materials for rubber, plastic films, and coated fabrics," by H. N. Vosmer, Wright Air Dev. Center Technical Rep. 57-296 (Feb. 1958).

651. "Methods for joining plastics parts," by A. J. Cheney and W. E. Ebeling, SPE J. 14, 31-39 (Mar. 1958).

652. "Joining and fastening plastics," by M. W. Riley, Materials in Design Eng. 47, 129-144 (Jan. 1958).

653. "Magnetic-force welding," by F. R. Parks, Product Eng. 29, 82-85 (Sept. 15, 1958).

654. "Chemical frosting of methacrylate plastics," by R. H. Bicker and R. G. Winter, Rev. Sci. Instr. 28, 843 (1957).

655. "Operation dust-free," Modern Plastics 35, 102-103 (Feb. 1958).

Applications

656. "Plastics' stake in agriculture," Modern Plastics 35, 91-93, 215, 217 (Apr. 1958).

657. "Seed protection," Modern Plastics 35, 200 (Feb. 1958).

658. "How can we hurdle the 'material roadblock'?" by I. Stambler, Aviation Age 30, 18-19 (Aug. 1958).

659. "High-temperature insulating materials in aircraft electrical components," by H. Wood, Plastics Inst. Trans. and J. 25, 231-239 (July 1957).

660. "Foamed styrene cuts missile costs," MPL. 36, 167-168 (Nov. 1958).

661. "Plastics tooling for the aircraft industry," by V. L. Malempre, Rubber and Plastics Age 39, 509-511 (June 1958).

662. "Plastics in cars on the upswing," by F. Giordano, Product Eng. 29, 27-28 (Mar. 24, 1958).

663. "Metal and plastic join forces," by G. G. Carr, Iron Age 181, 56-57 (Apr. 3, 1958).

664. "Plastics in boats," by H. A. Collinson, Plastics Inst. Trans. and J. 25, 154-170 (July 1957).

665. "Plastic barges closer," Chem. Week 83, 58 (Oct. 4, 1958).

666. "Plastics' stake in building," Modern Plastics 36, 99, 204 (Sept. 1958).

667. "A long range look at plastics in construction," by M. F. X. Gigliotti, Plastics World 15, 6 (Dec. 1957).

668. "New building methods build sales for sealants," Chem. Week 83, 67-68, 70, 72 (Sept. 13, 1958).

669. "Importance of adhesives and sealants in building," by A. G. H. Dietz, Rubber and Plastics Age 39, 229, 301-302 (Apr. 1958).

670. "New processes and technology," by R. A. Labine and C. C. Van Soye, Chem. Eng. 65, 125-138 (May 5, 1958).

671. "Design in plastic towers," by P. L. McWhorter, Chem. Eng. 65, 164, 166, 168 (Apr. 7, 1958).

672. "A new plastic packing for cooling towers," by A. L. Fuller, A. L. Kohl, and E. Butcher, Chem. Eng. Progress 53, 501-505 (Oct. 1957).

673. "How to select best plastic for tanks," by W. Reybold, Chem. Eng. 65, 152, 154, 156 (Mar. 24, 1958).

674. "Plastic heat exchangers gain in severe service," by Whitley, Chem. Eng. 64, 308, 310, 312, 314, 316 (Sept. 1957).

675. "Plastics diaphragm valves," by E. Ford, Rubber and Plastics Age 38, 873 (Oct. 1957).

676. "Latest in liners," Modern Plastics 36, 106-107 (Sept. 1958).

677. "Electronics: miracle market for plastics," Modern Plastics 35, 81-85, 207-208, 211-212, 214 (Mar. 1958).

678. "Using plastics in electronics," by L. D. Shergalis, Electronic Design 6, 18-21 (Sept. 3, 1958).

679. "Plastics for the electronics industry," by R. L. Mondano, Electronic Design 6, 22-27 (Sept. 3, 1958).

680. "Plastics as microwave dielectrics," by W. R. Cuming, Electronic Design 6, 32-35 (Sept. 3, 1958).

681. "Applications of plastics in electronics," Electronic Design 6, 40-49 (Sept. 3, 1958).

682. "Research progress in dielectrics," by A. E. Javitz, Electrical Mfg. 60, 94-103 (Dec. 1957).

683. "Eighteen uses of plastics in batteries," by I. C. Blake, Electronic Design 6, 36-39 (Sept. 3, 1958).

684. "Printed circuits in new telephone design," by M. Farr, Electrical Mfg. 61, 96-97, 310, 312 (Apr. 1958).

685. "A survey of materials, methods and equipment for printed circuits," by G. E. Rhine and S. M. Lewis, Plastics World 15, 14-52 (Nov. 1957).

686. "New fabrication techniques for flush circuitry," by E. L. Ditz and P. E. Ritt, Plastics Tech. 3, 819-823 (Oct. 1957).

687. "The loadbuster," Modern Plastics 35, 98-99, 196 (Mar. 1958).

688. "Control knobs for military elec-

tronic equipment," by T .G. Nessler, Electrical Mfg. 62, 115-118 (Sept. 1958).

689. "New military requirements for printed wiring protective coatings," by Geisler, Insulation 4, 20-24 (Aug. 1958).

690. "Super-thin bonded insulating films," by W. K. W. Chen and W. E. Estey, Electrical Mfg. 62, 84-89, 274 (Aug. 1958).

691. "Fibrous and nonfibrous insulation for use in high-voltage power equipment," by W. J. Renwick and R. H. Blewitt, Plastics Inst. Trans. 26, 23-48 (Jan. 1958).

692. "Thermoplastics in the submarine cable industry," by J. Dean, Plastics Inst. Trans. and J. 25, 171-190 (July 1957).

693. "Tomorrow's plastics packages. Modern Plastics 35, 95-101, 222-227 (May 1958).

694. "Film sparkles at Packaging Show," Modern Plastics 35, 204, 206 (Aug. 1958).

695. "Properties of plastic films," Materials in Design Eng. 46, 149, 151, 153 (Dec. 1957).

696. "Innovations through skin and blister packaging," by D. S. Threlkeld, Plastics Tech. 3, 545-546 (June 1958).

697. "Heat sterilization in plastics," by E. Wallenberg and B. Jarnhall, Modern Packaging 31, 165-167, 233, 235 (Sept. 1957).

698. "For plastic pipe: Progress with problems," Chem. Week 83, 77-78 (Aug. 9, 1958).

699. "Plastics coating for buried pipe," by W. D. Parker, Corrosion Tech. 5, 179-180 (June 1958).

700. "Plastic pipe in the chemical process industry," by R. B. Seymour, Plastics Tech. 4, 46-50, 59-60 (Jan. 1958).

701. "Fibers," by C. S. Grove, Jr., R. S. Casey, and J. L. Vodonik, Ind. Eng. Chem. 50, 1444-1448 (Sept. 1958).

702. "'Engineered' fabrics: What they can do," by L. A. Runton, Materials in Design Eng. 48, 90-92 (July 1958).

703. "Man-made fibers weave glowing future," by E. Schwartz, Chem. Week 82, 93-115 (Mar. 8, 1958).

704. "Plastics stake in furniture," Modern Plastics 35, 114-117, 222-224, 226 (June 1958).

705. "Plastics stake in footwear," Modern Plastics 35, 90-92, 186 (Aug. 1958).

706. "Synthetic tap pieces for shoes," by J. D. Harris, Rubber and Plastics Age 39, 141 (Feb. 1958).

707. "Small skeletons for mass markets," Modern Plastics 36, 100-101, 206 (Sept. 1958).

708. "Humane role for plastic: substituting for various faulty parts of the body," Chem. Week 82, 26-27 (Mar. 1, 1958).

709. "Industrial protective clothing helps to reduce accidents," by G. Baston, Machinery Lloyd 30, 90-93 (Apr. 26, 1958).

710. "Photocopy swings to plastics," Modern Plastics 36, 108-109, 208-210 (Sept. 1958).

711. "Plastics in conveyor belting with special reference to the mines," by C. G. Addingley, Plastics Inst. Trans. 26, 227-250 (July 1958).

712. "Plastics as solid lubricants and bearings," by A. J. G. Allan, Lubrication Eng. 14, 211-214 (1958).

713. "Characteristics of plastic scintillators," by L. J. Basile, J. Chem. Phys. 27, 801-804 (Sept. 1957).

714. "Opportunity lost?" Rubber and Plastics Age 39, 130-131 (Feb. 1958).

715. "Use of plastics in the button industry," by H. F. Fields, Plastics (London) 23, 268-269 (July 1958).

716. "Neoprene-based sole-laying adhesive," Rubber and Plastics Age 39, 293 (Apr. 1958).

717. "Hydrogenated polybutadiene as bonding agents for plastics and metals," by D. Wright and N. Parkman, Brit. Plastics 31, 255 (June 1958).

718. "Which adhesive for what?" by R. W. James and R. W. Gormly, Product Eng. 29, 79-81 (Mar. 17, 1958).

719. "6-Million-pound opportunity for adhesives," Chem. Week 81, 41, 43 (Dec. 21, 1957).

720. "Structural adhesives," by H. H. Rosenbaum, Aviation Age 30, 92 (Aug. 1958).

721. "'Glass-sandwich' resin can join metals," by S. Maziliauskas, Chem. Eng. 16, 152 (Aug. 11, 1958).

722. "Structural adhesives for metals," by H. C. Engel, Rubber and Plastics Age 39, 595-597 (July 1958).

723. "Adhesion using molecular models. Adhesion of polyethylene and poly(vinyl chloride) to metals," by D. Taylor, Jr. and J. E. Rutzler, Jr., Ind. Eng. Chem. 50, 928-934 (June 1958).

724. "Tacky adhesion," by H. Strasburger, J. Colloid Sci. 13, 218-231 (June 1958).

725. "Bonding of cementitious materials," by D. Goeke, Rubber and Plastics Age 39, 223-224 (Mar. 1958).

726. "The ultracentrifuge as an instrument for testing adhesion," by R. L. Patrack, W. A. Vaughan, and C. M. Doede, J. Polymer Sci. 28, 11-16 (Feb. 1958).

727. "Method for measuring shrinkage stress in restricted gelatine films," by R. C. Weatherwax, B. Coleman, and H. Tarkow, J. Polymer Sci. 27, 59-66 (Jan. 1958).

728. "A disk shear test for adhesives," by S. B. Twiss and L. B. Clougherty, ASTM Bulletin No. 232, 57-61 (Sept. 1958).

729. "Stresses in adhesive joints," by H. H. Perry, Product Eng. 29, 64-67 (July 7, 1958).

730. "Effect of loading rate on adhesive strength," by F. Moser and S. S. Knoell, ASTM Bulletin No. 227, 60-63 (Jan. 1958).

731. "Topography of pressure-sensitive adhesive films," by C. W. Hock and A. N. Abbott, Rubber Age 82, 471-475 (Dec. 1957).

732. "Silicone coatings for metal products," by L. F. Stebleton, Materials and Methods 45, 112-115 (Feb. 1957).

733. "Water-thinned paints: How they compare for metal products," Materials in Design Eng. 47, 100-103 (May 1958).

734. "Use of plastics in latex form," by J. Brydson, Plastics (London) 23, 11-13 (Jan.); 62-63 (Feb. 1958).

735. "Protective coatings," by F. Scofield, Ind. Eng. Chem. 50, 1479-1481 (Sept. 1958).

736. "Which organic coating?" by H. R. Rothenberg, Materials and Methods 45, 102-106 (June 1957).

737. "Fluidized polymer deposition," by R. L. Checkel, Modern Plastics 36, 125-126, 128, 130, 132 (Oct. 1958).

738. "High-speed masking process," by R. W. Clogg, Modern Plastics 36, 123-124 (Oct. 1958).

739. "Insulative and conductive coatings," by E. Davis, SPE J. 14, 19-23 (May 1958).

740. "Special coatings will resist spill-

age," by R. Cushing, Chem. Eng. 65, 156, 158, 159 (Feb. 24, 1958).

741. "Scientists unravel mystery of coating technology," by S. W. Bradstreet, L. R. Kohan, and E. R. Nielsen, Industrial Labs. 8, 98-105 (Nov. 1957).

742. "How to protect metals with elastomeric linings," by L. A. Woerner, Materials in Design Eng. 64, 94-98 (Aug. 1957).

Properties

743. "Reliable properties can be guaranteed," by R. S. Jackson, Plastics Tech. 4, 831-835, 837-838 (Sept. 1958).

744. "Plastics—properties and applications," Product Eng. Design Digest C28-C30 (Mid-Oct. 1957).

745. "Plastics and rubber," Materials in Design Eng., Materials Selector 46, 144-181 (Mid-Sept. 1957).

746. "Can performance test be developed for finished molded articles?" by R. A. McCarthy, Plastics Tech. 3, 640-643 (Aug. 1957).

747. "On the necessity of fundamental and widened research in strength of materials," by M. V. Zaustin, ASTM Bulletin No. 226, 52-61 (Dec. 1957).

748. "Trends in German testing techniques," by F. Starzmann, British Plastics 30, 492-497 (Nov.) 538-542 (Dec. 1957).

749. "Tensile strength of plastics: Effects of flaws and chain relaxation," by F. Bueche, J. Applied Phys. 29, 1231-1234 (Aug. 1958).

750. "The elastometer—a simple device for measurement of elastic moduli of plastics at elevated temperatures," by R. A. Spurr, M. J. Heldman, and H. Myers, ASTM Bulletin No. 231, 65-67 (July 1958).

751. "Tensile properties of plastics at low temperatures," by J. Dyment and H. Ziebland, J. Applied Chem. 8, 203-206 (Apr. 1958).

752. "High speed tensile tests of thermoplastics," by R. E. Ely, Plastics Tech. 3, 900-903, 910 (Nov. 1957).

753. "Statistics and time dependence of mechanical breakdown in fibers," by B. D. Coleman, J. Applied Phys. 29, 968-983 (June 1958).

754. "Equivalent effects of time and temperature in the deformation of elastomers," by A. R. Payne, Plastics (London) 23, 182-184 (May 1958).

755. "Rebound relaxation spectra and principles of constant isoelastic curing rates," by M. Gordon and B. M. Grieveson, J. Polymer Sci. 29, 9-35 (May 1958).

756. "Mechanical degradation of high polymers," by D. J. Angier, R. J. Ceresa, and W. F. Watson, Chem. and Ind. 1958, 593-594 (May 17).

757. "Determination of dynamic modulus and internal friction of high polymers from creep measurements," by J. J. Benbow, Proc. Phys. Soc. (London) 69B, 885-892 (1956).

758. "Fracture of non-Newtonian fluids at high shear stresses," by A. B. Metzner, Ind. Eng. Chem. 50, 1577-1579 (Oct. 1958).

759. "A high shear rate capillary rheometer for polymer melts," by E. H. Merz and R. E. Colwell, ASTM Bulletin No. 232, 63-67 (Sept. 1958).

760. "Friction and abrasion characteristic of plastic materials," by M. A. Marcucci, SPE J. 14, 30-33 (Feb. 1958).

761. "Electrical effects accompanying the stick-slip phenomenon of sliding of metals on plastic and lubricated surfaces," by G. W. Sohl, J. Gaynor, and S. M. Skinner, Trans. ASME 79, 1963-1970 (Nov. 1957).

762. "Plastics for abrasion resistance," by J. P. Abbat, Product Eng. 29, 105-107 (Mar. 31, 1958).

763. "Measuring the abrasion resistance of plastic lenses for sunglasses," by P. M. Kamath and H. O. Buzzell, Plastics Tech. 4, 132-136, 152 (Feb. 1958).

764. "Onset test for stability of uncatalyzed polymerization resins," by T. E. Bockstahler, A. P. Kotloby, E. M. Beavers, F. H. Zimmerli, and O. C. Kohler, Ind. Eng. Chem. 50, 1581-1582 (Oct. 1958).

765. "Effect of structure on the thermal decomposition of polymers," by L. A. Wall and R. E. Florin, J. Research NBS 60, 451-458 (May 1958).

766. "Flame resistance in neoprene," by Thompson, Hagman, and Mueller, Rubber Age 83, 819-824 (Aug. 1958).

767. "Flame-spread properties of building finish materials," by D. Gross and J. J. Loftus, ASTM Bulletin No. 230, 56-60 (May 1958).

768. "Small tunnel-furnace test for measuring surface flammability," by H. D. Bruce and V. P. Miniutti, ASTM Bulletin No. 230, 61-68 (May 1958).

769. "Vicat softening point test for plastics," by C. E. Stephenson and A. H. Wilbourn, ASTM Bulletin No. 224, 28-31 (Sept. 1957).

770. "Thermal insulation," by C. M. Bosworth, Product Eng. 28, 97-100 (Nov. 11, 1957).

771. "Vapor transfer through barriers," by K. Kammermeyer, Ind. Eng. Ind. 50, 697-702 (Apr. 1958).

772. "A diffusivity approach for studying polymer structure," by I. Auerbach, W. R. Miller, W. C. Kuryla, and S. C. Gehman, J. Polymer Sci. 28, 129-150 (Feb. 1958).

773. "Halogen-vapor transmission," by M. R. Rogers, E. Pillion, and A. M. Kaplan, Modern Packaging 30, 176-178, 238, 240 (Nov. 1957).

774. "Permeability of gases and vapors through composite membranes; permeability valves," by C. E. Rogers, V. Stannett, and M. Szwarc, Ind. Eng. Chem. 49, 1933-1936 (Nov. 1957).

775. "Thermo-osmosis of gases through polymers. The transient approach to the steady state," by C. M. Crowe, Trans. Faraday Soc. 53, 1413-1422 (Nov. 1957).

776. "Diffusion with special reference to high polymers," Trans. Faraday Soc. 53, 1145-1150 (Aug. 1957).

777. "Dielectric properties of solid polymers," by L. de Brouckere and G. Offergeld, J. Polymer Sci. 30, 105-118 (July 1958).

778. "Dielectric losses and polarization of polymers," by G. P. Mikhailov, J. Polymer Sci. 30, 605-614 (July 1958).

779. "Dielectric heat-stability of films," by G. I. Addis, L. A. Rosenthal, and E. Flowers, Plastics Tech. 3, 542-544 (June 1958).

780. "Commercial electrical insulating materials. Tables of properties," Insulation 4, 32-33 (Feb.); 32-33 (Mar.); 32-33 (Apr.); 30-31 (May 1958).

781. "Effects of plastics on bacteria," by W. G. Walter, B. Beadle, R. Rodriguez, and D. Chaffey, SPE J. 14, 36-37, 54 (Aug. 1958).

782. "Health safety of plastics," by D. D. McCollister and W. J. Sauber, Plastics Tech. 4, 812-814, 838 (Sept. 1958).

783. "Photothermoelasticity: an explor-

atory study," by G. Gerard and A. C. Gilbert, J. Applied Mech. *24*, 355-360 (Sept. 1957).

784. "A photoelastic study of strain waves caused by cavitation," by G. W. Sutton, J. Applied Mech. *24*, 340-348 (Sept. 1957).

785. "Surface tension of synthetic high polymer solutions," by H. L. Frisch and S. Al-Madfai, J. Am. Chem. Soc. *80*, 3561-3565 (July 20, 1958).

786. "Surface tension of viscous polymers," by H. Tarkow, J. Polymer Sci. *28*, 35-43 (Feb. 1958).

787. "Surface and interfacial monolayers of high polymers," by M. J. Schick. J. Polymer Sci. *25*, 465-478 (Sept. 1957).

788. "Adsorption of certain high polymers by carbon in dilute solutions," by A. I. Yurzhenko and I. I. Maleyev, J. Polymer Sci. *31*, 301-307 (Sept. 1958).

789. "Heats of wetting of modified collagen and other materials," by J. R. Kanagy and J. M. Cassel, J. Am. Leather Chemists' Assoc. *52*, 248-259 (1957).

790. "Development of paper chromatographic techniques," by A. D. Clarke and G. Bazill, Brit. Plastics *31*, 16-19 (Jan. 1958).

791. "Gas-liquid chromatography in a plastics analytical laboratory," by J. Haslam and A. R. Jeffs, J. Applied Chem. *7*, 24-32 (Jan. 1957).

792. "Configurational statistics of polymeric chains," by M. V. Volkenstein, J. Polymer Sci. *29*, 441-454 (June 1958).

793. "Molecular weight distribution of 'living' polymers," by W. B. Brown and M. Szwarc, Trans. Faraday Soc. *54*, 416-419 (Mar. 1958).

794. "Diffusion and viscosity measurements on macro-molecules in solution," by C. Rossi, U. Bianchi, and V. Magnasco, J. Polymer Sci. *30*, 175-186 (July 1958).

795. "Effects of capillary shape on flow characteristics and degradation of polymer solutions," by H. S. White and H. V. Belcher, J. Research NBS *60*, 215-219 (Mar. 1958).

796. "Osmotic pressure measurements with solute-permeable membranes," by J. L. Gardon and S. G. Mason, J. Polymer Sci. *26*, 255-275 (Dec. 1957).

797. "Osmotic pressures of moderately concentrated polymer solutions," by P. J. Flory and H. Daoust, J. Polymer Sci. *25*, 429-440 (Sept. 1957).

798. "Particle size and the rate of emulsion polymerization: a comparison of results obtained by electron microscopy and light scattering," by G. M. Burnett, R. S. Lehrle, D. W. Ovenall, and F. W. Peaker, J. Polymer Sci. *29*, 417-423 (June 1958).

799. "Theory of light scattering by polymer solutions," by P. J. Flory and A. M. Bueche, J. Polymer Sci. *27*, 219-229 (Jan. 1958).

800. "An improvement in the graphic treatment of angular light scattering data," by J. T. Yang, J. Polymer Sci. *26*, 305-310 (Dec. 1957).

801. "Direct ultracentrifuge molecular weights of synthetic high polymers," by G. Kegeles, S. M. Klainer, and W. J. Salem, J. Phys. Chem. *61*, 1286-1290 (Oct. 1957).

802. "Glass transition in polymers with (CH_{2n}) group," by A. H. Wilbourn, Trans. Faraday Soc. *54*, 717-729 (May 1958).

803. "Glass transition temperatures of copolymers," by L. A. Wood, J. Polymer Sci. *28*, 319-330 (Mar. 1958).

804. "Theory of molecular chain crystals and its application to high polymers," by W. Brandt, Ind. Eng. Chem. *50*, 1022 (July 1958).

805. "Isothermal volume contraction of amorphous polymers," by A. J. Kovacs, J. Polymer Sci. *30*, 131-147 (July 1958).

806. "Cold-drawing of glass-like and crystalline polymers," by J. S. Lazurkin, J. Polymer Sci. *30*, 595-604 (July 1958).

807. "A study of the elastic modulus and extensibility of the crystalline regions in highly oriented polymers," by W. J. Dulmage and L. E. Contois, J. Polymer Sci. *28*, 275-284 (Mar. 1958).

808. "A photoelectric instrument for the measurement of molecular orientation in films of high polymers," by N. N. Winogradoff, J. Polymer Sci. *26*, 187-198 (Nov. 1957).

809. "Polymers and the Kerr effect," Franklin Inst. Lab. Report *6*, 1-4 (Summer 1958).

810. "Degradation of addition polymers by ultrasonic waves. II.," by M. A. K. Mostafa, J. Polymer Sci. *27*, 473-480 (Jan. 1958).

811. "The estimation of free radicals trapped in a gel by electron spin resonance spectroscopy," by N. M. Atherton, H. W. Melville, and D. H. Whiffen, Trans. Faraday Soc. *54*, 1300-1303 (Sept. 1958).

812. "Electron spin resonance spectra of some alpha-irradiated polymers," by R. J. Abraham and D. H. Whiffen, Trans. Faraday Soc. *54*, 1291-1299 (Sept. 1958).

813. "Electron resonance studies of occluded polymer radicals," by D. J. E. Ingram, M. C. R. Symons, and M. G. Townsend, Trans. Faraday Soc. *54*, 409-415 (Mar. 1958).

814. "Mutual solubility of polymers and properties of their mixtures," by G. L. Slonimskii, J. Polymer Sci. *30*, 625-637 (July 1958).

815. "Critical concentration effects in polymer-polymer solvent systems," by C. C. Bigelow and L. H. Cragg, Canadian J. Chem. *36*, 199-205 (Jan. 1958).

816. "A study of diffusion in polymer solutions by the use of the polarization interferometer," by V. N. Tsvetkov and S. I. Klenin, J. Polymer Sci. *30*, 187-200 (July 1958).

817. "The phenomenon of 'inversion' in thermal diffusion of high polymer solutions," by I. Kossler and J. Krejsa, J. Polymer Sci. *29*, 69-75 (May 1958).

818. "Diffusion-controlled stress relaxation in polymers," by H. Fujita and A. Kishimoto, J. Polymer Sci. *28*, 547-585 (Apr. 1958).

819. "Transfer of energy in solid plastic solutions," by P. Avivi and A. Weinreb, J. Chem. Phys. *27*, 716-720 (Sept. 1957).

Standards

820. "ASTM Standards on Plastics," American Society for Testing Materials, Philadelphia 3, Pa. (Sept. 1958).

821. "Report of A.S.T.M. Committee D-14 on Adhesives," Proc. A.S.T.M. *58*, preprint (1958).

822. "Report of A.S.T.M. Committee D-11 on Rubber and Rubber-like Materials," Proc. A.S.T.M. *58*, preprint (1958).

823. "Guide to materials standards and specification. Part 1. Government and national standards," by S. P. Kaidanovsky, Materials in Design Eng. *47*, 96-100 (Mar. 1958); Part 4. Plastics and rubber, ibid. 113-117 (June 1958).—END

ISO meeting

(From p. 107)

Standard Laboratory Atmosphere and Conditioning Procedures is studying conditioning procedures for polyamides as well as methods for producing atmospheres of specified relative humidity in small enclosures. The ISO ATCO Committee has been requested to prepare a document on the methods of measurement and control of relative humidity in large and small enclosures.

Working Group No. 4 on Thermal Properties is preparing draft proposals for flammability of thin sheet and film, flow properties of thermoplastic and thermosetting materials, stiffness in torsion as a function of temperature, low temperature brittleness, and hot-needle penetration of plastics materials.

Working Group No. 5 on Physical Chemical Properties is preparing methods for gel time and maximum temperature attained in the setting of polyesters, chlorine acetate and polystyrene.

Working Group No. 6 on Aging, Chemical, and Environmental Resistance is working on the determination of resistance to natural light, carbon arc light, and weathering under natural and artificial conditions, changes in mechanical properties after contact with chemicals, and environmental stress-cracking of polyethylene.

Working Group No. 7 on Preparation of Test Specimens is designing a positive, semi-automatic mold for thermosetting test specimens and is studying the problem of producing stress-free and orientation-free plates which would find use in the determination of certain mechanical properties.

Working Group No. 8 on Electrical Properties is studying draft methods prepared by IEC/TC 15 for measuring insulation resistance, electric strength, dissipation factor, and loss index, and is considering thickness tolerances for laminates and corrosion of metals in contact with insulating materials. It referred to IEC/TC 15 for consideration a method for determining homogeneity by measurement of volume resistivity.

The American delegation to the ISO/TC 61 meeting consisted of C. H. Adams, leader (Monsanto), W. E. Brown (Dow), R. Burns (Materials Advisory Board), C. L. Condit (S.P.I.) A. A. Harban (Standard Oil of Ind.), T. Hazen (Union Carbide), G. M. Kline, F. W. Reinhart, and A. H. Scott (National Bureau of Standards), N. A. Skow (S.P.E., Synthane), F. Y. Speight (A.S.T.M.), A. C. Webber (Du Pont), P. E. Willard (Food Machinery), G. H. Williams (Bell Telephone), R. R. Winans (Navy), R. K. Witt (Johns Hopkins), and E. Y. Wolford (Koppers). Sponsors for the meeting and program were the American Society for Testing Materials Committee D-20, the Manufacturing Chemists' Association, the Society of Plastics Engineers, and the Society of the Plastics Industry.

The meeting in Washington was preceded by an international symposium in Philadelphia on October 30-31. The program, arranged by A. C. Webber, chairman, and sponsored by A.S.T.M. Committee D-20, included papers on standards developments in various countries, testing of plastics for mechanical and thermal properties, and determination of molecular characteristics of high polymers. The proceedings for the symposium will be printed in an A.S.T.M. Special Technical Publication.

1959 Meeting

The ninth meeting of ISO/TC 61 will be held in Munich, Germany, October 26-31, 1959. Immediately preceding this meeting will be a symposium of the IUPAC Macromolecular Commission in Wiesbaden on October 12-16, a symposium on aging, chemical, and environmental resistance of plastics by the IUPAC Division of Plastics and High Polymers in Düsseldorf on October 19, the German International Plastics Exposition "Kunststoffe 1959" in Düsseldorf on October 17-25, and the annual event "Deutsche Kunststoff-Tagung" on October 20-21.—END

THE PLASTISCOPE*

News and interpretations of the news

By R. L. Van Boskirk

Section 2 *(Section 1 starts on p. 39)*

January 1959

Plastics blocks for prototypes

Molded blocks in a wide range of plastics materials are now manufactured to order by Cadillac Plastic & Chemical Co., Detroit, Mich.

The low-cost blocks are used to hand carve or hob pre-production samples of injection molded pieces at a fraction of the cost and time of sample molding runs. This method enables injection molders to check weights and define molding techniques before bidding, and it may also suggest cost-saving design modifications before ordering production molds.

The blocks are also used by designers to submit low-cost prototypes for customer's final approval, engineering test runs, or consumer use tests.

The company's block molding process has already been applied successfully to all formulations of polystyrene, and the various densities of polyethylene; also to polypropylene, acetate, butyrate, Implex modified acrylic, and ABS polymer blends.

Color can be molded into the blocks as desired, the company states. Size range of the molded blocks is 16 by 16 by 1, 2, 3, or 4 in.; or 8 by 8 by 1¾ inch. Blocks may be ordered in any quantity from one up.

Cadillac Plastic also offers nylon and Teflon in standard extruded blocks, and acrylic in cast hobbing blocks.

Changes distribution policy

A working agreement covering cellulosic sheet distribution has been reached between Georg von Opel Corp., 15 William St., New York, N. Y., U. S. representatives of Dynamit A. G., formerly Alfred Nobel Co., Troisdorf-Cologne, Western Germany, and Rowland Products, Inc., Kensington, Conn. Rowland will handle sales, distribution, and warehousing of imported cellulose acetate and cellulose nitrate sheets for the optical industry, for drum shells and accordion keyboards, and for piano keys.

Sheets are available in thicknesses from 0.005 in., in trimmed sizes 20 by 50, and 24 by 55 in., and in a large variety of patterns and colors, including transparent, translucent, and opaque; pearlescent, tortoise shell, mosaic, metallics, brocade, and others.

The Georg von Opel Corp. will continue to handle sales and distribution of cellulose acetate and cellulose nitrate sheet for all other applications such as hampers, toilet seats, bathroom fixtures, drafting equipment, etc. Other distributors to handle sales of resins and film may be appointed later.

Dynamit A. G. is a leading European producer of plastics raw materials and semi-finished plastics products, and the Georg von Opel Corp. distributes the complete line of "Troisdorf plastics" in the U.S.

Bacteriostatic additive

Licenses to producers of molding compounds and to molders for a process to render plastics materials bacteriostatic and self-sterilizing are offered by Puratize, Inc., a subsidiary of Gallowhur Chemical Corp., Ossining, N. Y.

The process involves the addition of minute quantities of custom-made bacteriostats to the resin, colorant, or plasticizer. According to the company, each additive is designed to be compatible with the base resin, such as phenolics, polystyrene, polyethylene, melamine, etc., and to be stable at molding temperature. The additive does not affect the physical properties of the resin, or its color, the company states. Puratize supplies the additive and formulation recommendations. The licensee, who is permitted to use a Puratize label on his products, pays a fee based on the number of units so produced.

Metallic colors for vinyl

Colorants designed to impart metallic effects on vinyl sheeting and coated fabric have been introduced by Interchemical Corp. Finishes Division. Application is by gravure printing, knife-coating, or spraying.

Designated Auravin, the colors comprise a group of ready-mixed gold, copper, and silver shades, as well as a broad group of toners for producing other metallic effects. The gold, copper, and silver shades are available in ready-to-use form, except for thinning.

For producing metallic reds, browns, blues, greens, etc., Interchemical offers a group of toners which may be blended with an aluminum ink and a clear extender. Sparkling pastels or rich deep colors can be obtained, depending on the ratio of toner to aluminum ink.

The metallic colors are said to dry with the same speed as conventional vinyl inks and should be handled in the same manner. In laboratory tests, Auravin colors have shown virtually no change on up to 400 hr. exposure in an Atlas Fadeometer the company reports.

Interchemical also supplies clear topcoats to increase the abrasion resistance and impart increased depth to the colors on heavy gage sheeting and coated fabrics. Special formulations for light-gage vinyl are also available in ready-to-use form.

Epon designation

Redesignation of the numbering system of several of its Epon epoxy resins has been announced by Shell Chemical Corp. Basically there are 12 formulations. The "800" line signifies *(To page 204)*

*Reg. U.S. Pat. Off.

THE PLASTISCOPE

(From page 202)

liquid and the "1000" line solid resins. Generally speaking the latter are coating resins and the former are structural types for use in adhesives, encapsulation, and tooling; there is, however some overlap. Resins of the structural type that were formerly 562, 864, and 864-C-75, are now designated as 812, 836, and 836-C-75. Solid resins that were formerly 1310 and 1310-B-80 are now designated as 1031 and 1031-B-80.

Graduate plastics course

A program of study leading to the degree of M. Sc. in Engineering is offered by Princeton University. Instruction covers basic theory and properties, evaluation, production, fabrication, design and application of materials, as well as chemistry of plastics.

Fellowships with stipends of from $1,500 to $2,100 plus tuition and fees are available. Opportunities for employment as half-time research assistants at $2,100 per academic year are also offered.

Applicants for admission must hold a Bachelor's degree in engineering or physical science, and must meet general admission requirements of the Graduate School of Princeton. Further information can be obtained from Prof. Louis F. Rahm, Dir., Plastics Lab., Princeton University.

Rigid PVC pipe uses increase in Europe

A recent news item in this section, mentioning that the U. S. Navy had ordered 50 miles of polyvinyl chloride pipe has drawn comments from European readers, who point out large-scale uses in their own country.

Recently, the water supply company of Odense, Denmark, ordered nearly eight miles of 8-in. rigid PVC pipe with a nominal working pressure of 85 p.s.i and a test pressure of 522 p.s.i. This pressure pipe line weighs between 80 and 90 metric tons. One of the suppliers of this PVC pipe, Polyplex Danish-American Plastics Co., Copenhagen, Denmark, points out that the city of Odense has been using plastics pipe since 1953, and evaluated new materials prior to ordering polyvinyl chloride for this application.

In England, demands for high-impact PVC material is increasing rapidly, according to Extrudex, Ltd., a leading supplier of tube and fittings. The biggest installation in England is said to be an effluent pipe line, where 12,000 ft. of 4-in. and 6-in. Geon Hipact tubing is in use. British water authorities are increasingly approving the material for water services, and PVC is in widespread use in plants where resistance to chemical corrosion is important. Impact PVC now accounts for nearly 75% of the firm's unplasticized PVC output.

In another installation, British Geon Ltd., reports considerable savings as a result of installing a 400-ft. length of 12-in. high-impact PVC piping for effluent disposal in place of metal pipe. During the 12 months since its installation, the pipe has remained completely unaffected. Metal pipe previously employed had been found to corrode badly and needed frequent replacing, the company reports.

Custom blow molding service

Design and production of blow molded articles for industrial and proprietary products are activities now added to the custom molding services offered by A. J. Renzi Plastic Co., Leominster, Mass. The company also provides consulting services on blow molded items.

Plastic tooling seminars

A series of seminars on plastic tooling techniques and applications is being staged by Ren Plastics, Inc., Lansing, Mich., in various industrial centers.

The one-day presentations include talks by the company's representatives on the use of epoxy resin tooling compounds, showing of specially prepared films covering fundamentals of plastic tooling, and demonstration of the use of epoxy resin compounds for making tools and other applications. The following meetings have been scheduled: St. Louis, Mo. (Jan. 21), Buffalo, N. Y. (Jan. 28), New York, N. Y. (Feb. 10), Cincinnati, Ohio (Feb. 24), Pittsburgh, Pa. (March 17).

Flexographic inks

Adhesion to highly plasticized cellulose acetate films is claimed for the Maxiprint series of universal flexographic inks, manufactured by Claremont Pigment Dispersion Corp., Roslyn Heights, L. I., N. Y.

According to the company, print adhesion and block resistance remain very good after aging under both accelerated tests and ordinary storage conditions. No special printing techniques are required, the company states.

Informative labeling awards

Winners of the 4th Annual Informative Labeling Contest sponsored by the Society of the Plastics Industry, Inc. were: Grand Award: Gering Products, Inc.—four labels for garden hose; Apparel: Scott Paper Co., Foam Div.—tie tag for Scottfoam interlining; Building Materials: Gering Products, Inc.—labeling on box of Miracle Tape; Floor and Wall Covering: Cohn-Hall-Marx Co., Comark Plastics Div.—Labeling on back of Sculpture Con-Tact; Hardware: Gering Products, Inc.—four labels for garden hose; Home Furnishings: Farley & Loetscher Mfg. Co.—label for Farlite table top; Housewares: American Cyanamid Co., Plastics & Resins Div.—Booklet and labels for Cymac and Cymac Super; Notions: The Risdon Mfg. Co.—counter cards for Risdon self cover buttons; Toys: Federal Tool Corp.—label on toy bucket and TV seat; Miscellaneous: Kem Plastic Playing Cards, Inc.—folder and instruction card.

There were 105 entries from 49 companies.

Boilable housewares

Introduction of a line of boilable plastic housewares items, backed by full page ads in consumer magazines and newspapers has been announced by Beacon Plastics, Newton, Mass. The items are molded from Marlex high-density PE. Included are a three-piece mixing bowl set, (To page 206)

THE PLASTISCOPE

(*From page 204*)

a two-quart pitcher for hot or cold beverages, a colander, 15-in. round dish pan, tumblers, refrigerator dishes, and a baby bath.

Invests in model building company

Through an investment of approximately $300,000, Roxbury Carpet Co., Saxonville, Mass., acquired 2000 shares of the preferred stock and one-third of the common stock of Atkins & Merrill, Inc., builders of industrial scale, mockup, and prototype models.

Atkins has plants at South Sudbury and Marlboro, Mass. The latter houses the Laminated Fiberglas Div., which specializes in molded and laminated fibrous glass reinforced plastic products, including full size jet-engine mockups, aircraft cockpits for training purposes, special optical parts and components, space helmets, diving equipment, etc.

De-lustered Mylar

New low-cost flat-finish Mylar is being produced by Flexcon Co., Spencer, Mass. According to the company, the non-glare effect is not a coating, and the polyester film retains all the mechanical and chemical surface properties of Mylar.

This material is presently being evaluated for wall coverings, curtain wall panels, pressure-sensitive tapes, and other uses.

Molded PVC shoes

Injection molded polyvinyl chloride footwear, now being produced by Utrilon Corp., in a new plant in Puerto Rico will be available for the 1959 spring selling season. The shoes will be distributed by International Shoe Co., St. Louis, Mo., under the brand name Fleets, while the Utrilon trademark will be used on shoes distributed by the Sentinel and Hampshire sales divisions.

Among the features of the new shoes are long life; no necessity to polish; and ease of washing. They are said to be moistureproof and resistant to oils and greases and can be produced in a wide range of colors. Available in styles and sizes for men, women and children, the shoes retail at between $1.98 and $4.98.

Utrilon has contracted with Sanitized, Inc., for exclusive rights to use that company's hygienic treatment in plastics footwear. The Sanitize treatment is said to provide an anti-germ hygienic finish, and will retard athlete's foot fungi in shoes, and resist the development of odors, mold, mildew, and bacteria.

These molded shoes are also sold in Australia, England, France, and South Africa.

Standards for plumbing fixtures

The Dept. of Commerce presented to industry for consideration two recommended Commercial Standards—one for gel-coated glass-fiber-reinforced polyester resin bathtubs, TS-5428; and the other for gel-coated glass-fiber-reinforced polyester resin shower receptors, TS-5429.

Copies may be obtained from A. S. Best, Commodity Standards Div., U. S. Dept. of Commerce, Washington 25, D. C.

Polyether foam production simplified

A one-shot system that greatly simplifies the production cycle for converting basic urethane chemicals into commercial polyether foam cushioning stock has been developed by Mobay Chemical Co. The system eliminates much of the pre-mixing of earlier methods and simplifies curing requirements, while producing polyether foam that is said to meet the commercial standards for foams of equal density made by the prepolymer method.

A new combination of catalysts, using metallic compounds as key ingredients, is the basis of the new development, which also affords increased control over the rate of foaming.

According to Mobay, the new system produces a uniformly high quality foam of good appearance, cell structure, resiliency, shear resistance, and hydrolysis aging.

Mobay believes that it may take considerable transition time for the new technique to reach full commercial status because most present polyether foam manufacturing facilities have been geared to the prepolymer foaming system.

Expansion

H. B. Fuller Co., Ltd. of Canada has completed installation of equipment for the production of industrial adhesives at 1400 Sargent Ave., Winnipeg, Ma. The leased building contains 5000 sq. ft. of space for production, laboratory, and office areas.

Donald Giroux, formerly with Johnson & Johnson of Canada, named gen. mgr. of the plant.

Union Carbide Corp. exercised its option to purchase from **Amoco Chemicals Corp.**, the utilizable facilities which remain on the 306-acre tract at Brownsville, Texas, site of the processing plant formerly operated by Amoco. The option also includes the 42-mile Weslac-Brownsville natural gas pipeline.

Operations at this site will be carried on by **Union Carbide Chemicals Co.** and **Union Carbide Olefins Co.**, both divisions of Union Carbide Corp. However, Union Carbide is not contemplating the production of either synthetic gasoline or petroleum products, nor does it intend to produce chemicals by the Fischer-Tropsch process.

Reichhold Chemicals, Inc., has completed facilities for the manufacture of 15 million lb. of polyvinyl acetate emulsions annually at its Kansas City, Kan., plant.

At the same site, RCI is constructing a $500,000 plant designed to produce 30 million lb. of formaldehyde a year. This facility is scheduled to go on stream by April, 1959.

Engineering work for the construction of a $4 to $5 million plant capable of producing 60 million lb. of phenol per year is now in progress at Tacoma, Wash. Initial production (*To page 209*)

U.S.I. POLYETHYLENE NEWS

A series for plastics and packaging executives by the makers of PETROTHENE® polyethylene resins

Packaging Notes

Poly Cap for Lighter Fluid and Household Oil Cans features a valve spout that moves on an undercut track. The undercut design gives a tight seal which prevents both leakage and evaporation loss. The cap, which was developed after two years of testing, takes advantage of polyethylene's tendency to swell in contact with lighter fluid. The undercut valve component and undercut cap base both are designed to effect a tighter seal when swelling occurs. The caps are press-fitted to the cans with conventional polyethylene press-fit machinery.

Polyethylene gloves, strong enough to be reusable and inexpensive enough to be disposable, are now being marketed for both home and industrial use. The gloves are made of 1.75 mil polyethylene. Although strong, they do not impair the sense of touch as do gloves of other materials. They are presently being packaged in pocket packs of four and in economy rolls with up to 144 gloves on a roll. They are available in heavier gauges for industrial applications. The gloves reportedly have been cleared for use with radioactive materials by a leading radiation laboratory.

Gloves of 1.75 mil polyethylene are being packaged in economy rolls of up to 144 per roll and are available in heavier gauges for industrial applications.

"Woven" Polyethylene Bags for packaging citrus fruits and other produce may make their appearance soon. Poly strands are laid at intervals of about ⅜ths of an inch, then are heat-sealed to similar strands laid across them. The effect is an open, latticed material which has considerable strength. Decorative effects are obtained with strands of different colors.

Poly bag with two compartments separated by a simple polyethylene check valve permits dry premixes to be packaged in ready-to-use form. User simply adds liquid to upper compartment, squeezes it into premix compartment, then wet mixes the ingredients by kneading the bag. Check valve prevents leakage of contents. Products for which the newly patented package design is suggested include cake, pie crust and bread mixes, other wettable formulations such as glues, cements and plaster.

U.S.I. Holds Polyethylene Conference For Export Agents from Around the World

Discuss Latest Technical Developments, Growing Overseas Markets

Export agents representing 20 overseas markets were the guests of U.S.I. at a seven-day conference that included meetings in New York, Tuscola, Ill., and Chicago. Purpose of the conference was to review the latest developments in polyethylene technology and to discuss the rapidly growing markets for polyethylene abroad.

Export agents from 20 countries disembark from plane prior to visiting U.S.I. plant at Tuscola, Ill. for first-hand view of polyethylene resin production.

The 24 visitors represented markets which accounted for almost 75 percent of total U. S. polyethylene exports during the first six months of 1958. Represented were most of the European countries, South and Central America, the Far East, Near East and Mexico. Last year, U. S. polyethylene sales in these areas ran some 20% ahead of 1957, and further increases have been predicted.

After sales orientation meetings in New York, the conferees visited the giant petrochemical complex at Tuscola, where U.S.I. makes its PETROTHENE® polyethylene resins. U.S.I. research and production experts gave a series of lectures designed to bring the overseas visitors up to date on the latest developments in polyethylene resin production and processing.

The visitors moved on to Chicago for additional meetings and a press reception with editors of leading American plastics publications. The export representatives stayed on in Chicago to attend the National Plastics Exposition and the International Dinner of the Society of the Plastics Industry.

Poly Film Packaging Cuts Weight Losses in Peaches

Preliminary research conducted at a leading midwest agricultural experiment station indicates that prepackaging peaches in polyethylene film can cut weight losses in peaches which must be shipped over long distances.

In the tests, peaches were placed in plastic trays and overwrapped with perforated poly film. Weight losses during cold storage were reduced by 60%. Surface shriveling and dullness, usually encountered in bulk handling, were found to be eliminated in peaches which were packaged in film.

A controlled ripening schedule, in which the packaged peaches were ripened after a week in cold storage, was found to improve quality and reduce incidence of storage rots.

Borated Polyethylene: Order 6-8 Weeks in Advance of Use

Users of borated polyethylene are advised to schedule their orders six to eight weeks in advance of their projected use dates. The compounded resin picks up moisture from the air and must therefore be used within a short time after preparation. The six to eight week lead time on orders enables U.S.I. to schedule production for this specialized grade and insures delivery as close as possible to actual use date.

New Press Permits Printing Poly Film in Continuous Roll

A new printing press has been developed which enables polyethylene film to be printed in two colors at high speed without the need for stopping or reducing speed to join rolls.

Each reel stand of the new flexographic press carries two film reels, each independently driven. By synchronizing the speed of the full reel with the empty reel, the press permits a pasted joint to be made with no interruption or slow-down.

Speed of the press is said to be more than 450 feet per minute. The press is equipped with unit driers, a rotating mirror and web scanning device, static eliminator tension control and automatic paster on both unwind and rewind ends. The press will print two colors, with two more colors possible through the attachment of another unit.

(*From page 206*)

of the plant is 30 million lb. annually. Construction is expected to start during the latter half of 1959, and be completed in the latter part of 1960.

Reichhold Chemicals is also constructing a new plant at Niort, France—the company's second manufacturing facility in that country. Production of the Niort plant will consist largely of formaldehyde with a monthly capacity of 600 tons. Future plans also call for the production of pentaerythritol. The plant will be built by **Reichhold-Beckacite**, an affiliate of RCI.

Allied Chemical Co. completed a continuous naphthalene distillation unit at its Plastics & Coal Chemicals Div. plant, Philadelphia (Frankford), Pa. The facility was constructed by **Badger Mfg. Co.**, Cambridge, Mass.

Products made at the plant include crude solvent used in producing styrene for resins and industrial solvents; crude hi-flash for Cumar coumarone indene resins; and others.

Jefferson Chemical Co., Inc., has completed a new ethylene plant at Port Neches, Texas, which will triple the company's production capacity for ethylene. The company's over-all expansion will double the plant's capacity for ethylene glycol, increase by 50% the production of ethylene oxide, and permit Jefferson's entry into new fields based on ethylene and propylene.

The second unit of the expansion program—a direct oxidation plant for production of ethylene oxide—is about to be completed. Later on, a chlorine-caustic unit will be completed along with an ethylene glycol plant. Completing the expansion in the summer will be propylene glycol and propylene oxide units.

The Brunswick-Balke-Collender Co. has dedicated its new plant in Kalamazoo, Mich., which the company purchased from **CBS-Hytron Div.** some months ago. The 325,000 sq. ft. plant represents a 22% addition to the company's manufacturing area. Brunswick manufactures a complete line of classroom furniture needs, including fibrous glass-reinforced plastics chairs; bowling equipment and supplies; and aircraft and guided missile components. Sales for the first nine months of 1958 were $143 million, compared with $85 million for the same period in 1957.

Polymer Industries, Inc., a subsidiary of **Philip Morris, Inc.**, is planning to add 12,000 sq. ft. of manufacturing area, and 8500 sq. ft. of laboratory and office space to existing facilities at Springdale, Conn. Total cost of the new building and equipment will be about $360,000. Completion is scheduled for midsummer of 1959.

Air Reduction Co., Inc. has added a two-story $500,000 polymer laboratory to its research and development laboratories at Murray Hill, N. J. Particular emphasis will be placed on the development of polymers for plastics, films, coatings, adhesives, etc.

Enjay Co., Inc. has adopted Escon as a trademark for its polypropylene and started construction of a 30,000-sq. ft. plastics wing at its customer-service research labs at Linden, N. J.

Commercial quantities of Escon will be available early in 1960. Meanwhile, market-development supplies are being furnished by a ton-a-day pilot-plant operation.

Walter J. A. Connor, previously president of American Plastics Corp., New York, N. Y., has joined Enjay to help complete and activate the new marketing program. A veteran of 20 years in the plastics field, Mr. Connor was named asst. to Enjay's VP and sales mgr., **Karl J. Nelson.**

The Pantasote Co., California Div., moved its headquarters from 2627 San Fernando Rd., Los Angeles, to a new warehouse at 4703 E. 48th St., Vernon, Calif. Production of the company's Panta-Pak trays has already begun at the new California headquarters.

Borden Chemical Co. has started construction of a coatings and adhesives manufacturing plant at Illiopolis, Ill. The half million dollar facility is expected to be in production by July 1, 1959, and will replace the company's Reslac operation in Chicago, Ill., where manufacturing has been conducted in leased quarters since Borden acquired Reslac Chemicals, Inc., in 1955. Sales and technical services offices of the Coatings & Adhesives Department will be retained in Chicago.

Murray Corp., Towson, Md., manufacturers of all-stainless clamps for polyethylene pipe, has completed additions and modernizations which double the size of the company's facilities.

Mobay Chemical Co. has increased the manufacturing capacity for tolylene diisocyanate chemicals at its New Martinsville, W. Va., plant by 50%. These chemicals are used in urethane foams, elastomers, industrial paints, and wire coatings.

Fiber Glass Plastic, Inc., Miami, Fla., has purchased the assets of **Spun Lite Corp.**, and moved to 7395 N. W. 34th Court, Miami 47, Fla. The acquisition increases the company's plastics panel production capacities. The company is also adding a line of continuous corrugated material to be delivered in rolls, to its existing line of glass-fiber-reinforced panels.

United-Carr Fastener Corp., Cambridge, Mass., manufacturers of special-purpose fastening devices, has acquired **New England Tape Co.,** Hudson, Mass., manufacturers of electrical insulating tapes; a wide variety of plastics extrusions and coating materials; and metal-and-plastic assemblies.

Howard M. Wilkoff, pres. of New England Tape, will continue to operate the company as a division of United-Carr.

DeVilbiss Co. has expanded the customer facilities of its Cleveland, Ohio, direct factory branch;

a full line of spray painting and finishing equipment, hose and hose connections, air compressors, and service parts for all DeVilbiss products is now stocked at the branch office. Repair service by factory trained mechanics and engineering and sales facilities are also available.

Fisher Scientific Co., manufacturer-distributor of laboratory supplies, has opened a 115,000 sq. ft. plant for its Manufacturing Div. at Indiana, Pa. The new plant will supply instruments to Fisher plants in the U. S., Canada, and Mexico, but the instruments will continue to be designed in the company's development laboratories, Pittsburgh, Pa.

Deceased

Kenneth Macksey, 64, died Dec. 5 of a heart attack. He was co-founder with Don S. Kendall of **Mack Molding Co., Inc.**, Wayne N. J. in 1920. He was president of the company, which became one of the largest in the business, until his death. Mr. Macksey was widely known through his activities in industry affairs and his wise counsel on trade problems that frequently afflicted the plastics business. He was one of the original members of Plastics Pioneers.

K. Macksey

Grayson W. (Gay) Wilcox died suddenly Nov. 27, age 51. He had been on the **Durez** sales staff since 1937 in Detroit, Mich., North Tonawanda and New York, N. Y. He became widely known to thermosetting molders as an extremely conscientious and fair minded man when he handled phenolic molding materials and priorities for the War Production Board during World War II. He was inventor of the Wilcox vent plug, a valve used to vent gases from molds to prevent distortion of the molded

G. W. Wilcox

piece. He is survived by a wife Phyllis and 12-year-old son, Grayson, Jr.

Claude Emmett Brocklebank, Jr., 53, general sales mgr. for chemicals and plastics, **Union Carbide International Co.**, and vice pres. **Union Carbide Inter-America, Inc.**, died on October 24, 1958 at Durban, South Africa while on a business trip.

James S. Wilson, 58, who retired two years ago as vice pres. of **Bestway Products, Inc.**, and as pres. of **M & W Co.**, died on November 23, 1958. He held many patents on plastics molding machines, and developed a process for molding phonograph records from polystyrene.

Meetings

Plastics groups

February 3-5: The Society of the Plastics Industry, Inc., 14th S.P.I. Reinforced Plastics Div. Conference, Edgewater Beach Hotel, Chicago, Ill.

February 4: Society of Plastics Engineers, Inc., Western New England Section, Bradley Field, Terrace Dining Room, Windsor Locks, Conn. Subjects: "What's new in metalizing?" "Printing on polyethylene."

Other meetings

January 21-23: American Management Association, Special conference on plastic packaging materials, Biltmore Hotel, New York, N. Y.

February 2-6: American Society for Testing Materials, A.S.T.M. Committee Week, Penn-Sheraton Hotel, Pittsburgh, Pa. About 30 of the society's main technical committees will hold some 350 meetings of subcommittees and working groups.

February 6: University of Akron, Akron Polymer Lecture Group, Room 107, Knight Hall, University of Akron, Akron, Ohio. Subject: "Mechanical and physical chemical properties of diisocyanate-linked elastomers."

February 23-26: Technical Association of the Pulp and Paper Industry, 44th TAPPI Annual Meeting, Hotel Commodore, New York, N. Y.—END

COMPANIES . . . PEOPLE

Appointments, promotions, and relocations

Union Carbide Corp.: Morse G. Dial, previously pres. assumes the newly created office of chrmn. of the board, and continues as chief exec. officer.


H. S. Bunn

Howard S. Bunn promoted from Exec. VP to pres. **Kenneth H. Hannan** continues as Exec. VP, and **Birny Mason, Jr.**, previously VP becomes an Exec. VP.

Union Carbide Plastics Co.: Howard L. Burpo, Jr. named agricultural products mgr. to direct sale and service of the company's vinyl agricultural products such as portable silos, ditch and pond liners, irrigation tunnels, and tarpaulins.

Visking Co.: Harry C. Byrne, Jr. named asst. to VP—Plastics Div.

Monsanto Chemical Co., Plastics Div.: Dr. Edgar B. Graham joined the research dept. at Springfield, Mass. **Robert L. Maute** appointed a group leader in the research dept. at the Texas City, Texas, plant.

Organic Chemicals Div.: John H. Van Ness appointed group leader for research on maleic anhydride and phthalic anhydride at St. Louis, Mo.

Eastman Kodak Co.: Donald McMaster, previously VP and gen. mgr., elected chrmn. of the newly-formed exec. committee. He is succeeded by **William S. Vaughn. Louis K. Eilers,** formerly asst. gen. mgr. of Eastman Kodak, succeeds Mr. Vaughn as first VP, **Tennessee Eastman Co.,** and **Texas Eastman Co.,** and as pres. of **Eastman Chemical Products, Inc.**

Eastman Chemical Products, Inc.: Val Reisig, previously with Union Carbide Corp., named asst. to **Dennis C. Guthrie,** advertising mgr.

Chemicals Div.: New sales offices for industrial and specialty chemicals were opened at 3133 Maple Dr., N. E., Atlanta, Ga., and in the Jefferson Standard Bldg., Greensboro, N. C.

Borg-Warner Corp., Marbon Chemical Div.: Oscar Niemi named tech. service engineer to assist customers with injection molding problems.

Daniel J. Rowe appointed tech. sales rep. for the East Coast territory. **Farrington Mfg. Co.: D. H. Farrington** named chrmn. and chief exec. officer. **W. M. Tetrick** promoted from exec. VP to pres. and chief operations officer.

General Tire & Rubber Co.—Plastics Div.: George S. Laaff named coordinator of product research and development. He will retain his present duties as mgr. of research and development at the **Bolta Products Div.,** Lawrence, Mass. On a rotational basis, other research mgrs. of the div. will be appointed coordinator. **John E. Brigante** now mgr. of production control and inventory for the div.

Respro Div.: Robert E. Rehm now mgr. of the Cranston, R. I., plant.

Allied Chemical Corp. — National Aniline Div.: Herbert W. McNulty appointed asst. mgr.—market research.

Solvay Process Div.: Solon D. Fisher named asst. mgr.—St. Louis, Mo., sales branch. **John W. Priesing** appointed West Coast sales rep.

Barrett Building Materials Div.: Claude R. Veeder promoted from asst. mgr. to Western Dist. sales mgr.

Allied Chemical International: Grant E. Sita, formerly asst. to the pres., will head the newly established European office in Brussels, Belgium, **Dr. J. Ross Tuttle,** a VP, named tech. dir. of the European operations.

Diamond Alkali Co., Plastics Div.: H. E. Connors, formerly mgr. of packaging products for the Finishes Div., Interchemical Corp., named product mgr.—Diamond paste resins.

Charles E. Henry appointed sales rep. for Diamond PVC resins in Ohio, Ky., western Ind., and western Pa. **Phillip I. Johnson** assigned to cover the New York-Baltimore area as a PVC resin sales promotion rep. **Alexander A. Jigger** will cover the New England states as PVC resin sales rep. **James N. Jenkins** will handle customer service problems involving extrusion of PVC resins. **Raymond A. Chartier** and **Peter S. Weill** named tech. service reps. on calendering and paste resins respectively. **Herbert C. Jardine** appointed sales rep. to cover the southeastern states for the Plastics Div.

Electro Chemicals Div.: T. S. Dewoody, Jr. appointed to newly-created position of mgr.—tech. staff.

U. S. Rubber Co.: Edward J. Geise, former sales mgr. of Vibrin polyester resins, appointed asst. mgr. of commodity sales, **Naugatuck Chemical Div.** He is succeeded by **Robert P. White,** formerly tech. sales rep. for plastics in the Boston, Mass., area.

Plastic Papers, Inc. is the new corporate name of **Plastic Coated Paper Corp.,** New York, N. Y. **Dr. William Mullen** named dir. of research and prod. at the Hicksville, N. Y. plant.

University of Buffalo named the new chemistry building now under construction "The Edward Goodrich Acheson Hall of Chemistry," in honor of the founder of the **Carborundum Co.,** and the developer of colloidal graphite and other finely divided microscopic materials.

American Cyanamid Co.: R. A. Hoekelman, formerly gen. mgr., Plastics & Resins Div., appointed to newly-created post of dir.—customer relations.


L. Francisco

Plastics & Resins Div.: L. J. Francisco named gen. mgr. **W. D. Holland,** formerly with the Commercial Development Div., succeeds Mr. Francisco as asst. gen. mgr.

Organic Chemicals Div.: Eugene C. Medcalf named mgr.—intermediates dept. **Dr. J. C. Pullman,** formerly tech. mgr.—petrochemicals dept., named asst. to the commercial development mgr. He is succeeded by **Dr. Leonard G. Tompkins.**

Pigments Div.: John Ludden, Jr. appointed asst. mgr. of the Savannah, Ga., plant.

Reichhold Chemicals, Inc.: Irving H. Schupp promoted from tech. sales supv.—polyester resin dept. to dist. sales mgr.—plastics products at the Argo, Ill. offices. **W. Arthur Weismann** named sales promotion mgr.

Farris Engineering Corp., Palisades Park, N. J., manufacturers of valves, presses and metering devices formed an English manufacturing affiliate—**Farris Engineering Ltd.,** under an agreement between **Farris Engineering Corp., Farris Flexible Valve Corp.,** and **Associated Automation,** a subsidiary of **Elliott-Automation,** London, England.

United Ultramarine & Chemical Co., Inc., 149 Broadway, New York, N. Y., was formed to market ultramarine blue pigments and allied chemicals manufactured by the parent company, **Vereinigte Ultramarin Fabriken A. G.,** Köln, Western Germany. Previously, the German company's ultramarine blue was marketed in the U. S. by **American Cyanamid Co.**

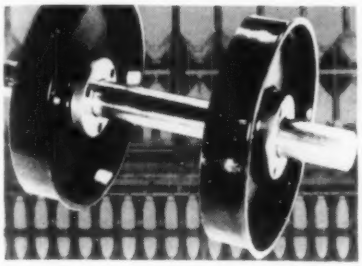
General Aniline & Film Corp.: John Hilldring, formerly pres., elected chrmn. of the board. He will continue as chief exec. officer.

Philip M. Dinkins, previously VP—gen. mgr. of the Dyestuff & Chemical Div., was elected pres.

Budd Co., Continental-Diamond Fibre Corp.: E. H. Baugh, previously Pittsburgh, Pa., sales mgr., now dist. sales mgr. in Cleveland area, succeeds **George H.** *(To page 214)*

PRODUCT-DESIGN BRIEFS FROM DUREZ

- **impact strength comes down in price**
- **fast-curing phenolic cures a cost problem**
- **new idea for closures**



High impact at low cost

These big pulleys help drive huge spinning frames made by Roberts Co., Sanford, N. C., a leading manufacturer of textile machinery.

Until recently, the pulleys were made of stamped metal or heavy cast iron. Designers looked for a better material—strong, dimensionally stable, low in cost. They found it in *Durez 18683.*

This new sisal-filled phenolic solves the cost problem of high-impact parts in three ways:

1. It costs only pennies more than general-purpose wood-flour-filled phenolics.
2. It molds by simple compression or transfer methods, using standard presses, standard pressures, standard dies.
3. It cures as fast as general-purpose compounds.

Durez 18683 molds dimensionally stable parts with impact strength of 1.4 ft. lb./in. Molded parts are self-extinguishing, have excellent resistance to humidity, and can meet U/L requirements for attached electrical contacts. You'll find that *18683* opens the way to savings on hundreds of applications where higher-cost materials are used now.

Consider it for heater and air-conditioner housings, instrument panels. Specify it for gears, wheels, pulleys, electric motor end bells—wherever you need impact strength and want it at lower cost.

The sooner you investigate *Durez 18683*, the sooner you can start saving with it! For bulletin, data sheet and/or evaluation sample, mail the coupon today.

Torrid tempo

Rapid production is beating out a new rhythm of lowered costs for the makers of these small lamp sockets (center column), Noma Lites, Inc.

The key notes are smart redesign, use of multi-cavity molds, and an exceptionally fast-curing Durez phenolic.

Formerly, the manufacturer bought one-piece sockets, forced metal screw shells into them, applied pitch to protect against moisture, then laboriously soldered in the wires.

Zip! Now, threads are molded into the split sockets by the molder, Holyoke Plastics Company Inc. Wires are laid across the socket halves. A simple metal clip joins the halves and pierces the wires with contacts.

Whoosh! Socket halves are molded 80 at a time. Into the molds goes speedy *Durez 265*, general-purpose compound that cures in a few seconds. Even at this dizzy rate, its batch-to-batch uniformity assures consistent molding.

Hurry! Want to snap things up a bit? *Durez 265* can probably help you do it. To see how, dash right over to your molders. Or shoot us coupon for data on *265* and other GP molding compounds.

A cap can be pretty

Not so long ago, you couldn't get this decorative effect in a molded plastic closure. Now you can.

It's done by wiping color into the debossed design. Debossing used to be the crux of the problem, because of the undercuts. It was impossible to make a workable mold cavity by machining, hobbing, or casting.

The solution: electroforming. The mold is built up in nickel around a soft, resilient master, which is then withdrawn from the cavity.

The process is a development of Armstrong Cork Company and Electromold Corporation. It gives the designer a new freedom—permits intricate textured effects like leather and wood grain, as well as the simpler ones you see here.

Durez is in the picture, too. Versatile phenolics, especially formulated for bottle and container caps, provide the requisite impact strength, resist chipping and cracking, and do not bleed when in contact with alcohol. If these qualities might help you uncork a closure idea or unbottle a bottleneck, we suggest you contact your molder on the use of Durez phenolics for closures.

For more information on Durez materials mentioned above, check here:

- ☐ High-impact low-cost phenolic, *Durez 18683* Bulletin and data sheet
- ☐ Evaluation sample of *Durez 18683*
- ☐ *Durez 265* (data sheet) and descriptive Bulletin 400

Clip and mail to us with your name, title, company address. *(When requesting samples, please use business letterhead.)*

DUREZ® HOOKER CHEMICALS PLASTICS

PLASTICS DIVISION
HOOKER CHEMICAL CORPORATION
12001 Walck Road, North Tonawanda, N. Y.

(From page 212)

Shima, who will direct Western sales from Los Angeles, Calif. **Dan DeBow,** formerly at the Detroit, Mich., office, assumes responsibility for the Pittsburgh sales office. **Dewey F. Patterson** transfers to Detroit from the Dayton, Ohio, office.

Progressive Color & Chemical Co., Inc., New York, N. Y.: **H. E. Maurer** named pres., and **Walter Lau,** VP. The company, a subsidiary of **Intercontinental Chemical Corp.,** distributes chemicals, intermediates, and other products manufactured by **Farbwerke Hoechst A. G.,** Frankfurt-Hoechst, West Germany, and also distributes chemicals produced by **Hoechst Chemical Corp.,** West Warwick, R. I.

Hostawax Co., a newly-formed div. of Progressive Color, appointed sole distributor of waxes made by Farbwerke Hoechst. The German co.'s waxes, including lubricants for the plastics industry, were formerly known as Gersthofen (I.G.) waxes.

Kurt J. Wasserman, previously tech. dir. of Wax & Rosin Products, joined Hostawax.

Brookside Tool, Inc., 3505 E. Olympic Blvd., Los Angeles, Calif., a company newly-formed by **Ben Brearly** and **Clarence Shinsky,** previously tooling supts. at Papermate, will specialize in lapping and polishing work.

Waljohn Plastics, Inc., manufacturers of Tourex brand thermoplastic extrusions, has severed its relationship with **Studner-Kavaler Co.,** New York, N. Y., and will service customers directly from its plant at 437 88th St., Brooklyn, N. Y.

Ed Schlang named engineering sales mgr.; **Martin Dohren** is prod. mgr.; and **Martin Muckler** appointed to a liaison function for sales and production.

Raybestos-Manhattan, Inc. moved its district warehouse and offices from 131 Mission St., to 168 Beacon St., South San Francisco, Calif.

The larger facilities will represent the company's **Plastic Products Div., Manhattan Rubber Div., Raybestos Div., Packing Div.,** and **Asbestos Textile Div.**

Goodyear Tire & Rubber Co., Chemical Div.: A. E. Whitney, Jr., formerly special rep. in New York, N. Y., appointed to newly-created post of regional field sales mgr.—vinyl resins. He will coordinate all phases of the div.'s eastern sales of vinyl resins between consumers and the company's Akron, Ohio, sales offices and laboratories. Mr. Whitney will continue to operate from the New York office.

Edward C. Brown, Jr., special rep. in New York, transferred to the Philadelphia, Pa., office, where he will be concerned chiefly with sale of Pliovic vinyl chloride resins, Plioflex, and synthetic rubber.

Erie Engine & Mfg. Co., Erie, Pa.: **Lloyd Adam** promoted from sales mgr. to VP—sales and admin. **Ray Weller** named chief engineer. **Tom Kramer** appointed hydraulics and applications engineer.

Lloyd Adam

Ray Weller

The Society of the Plastics Industry, Inc., Reinforced Plastics Div.: William T. Scott, Atlas Powder Co., and **Harry L. Darby, Winner Mfg. Co., Inc.,** appointed chrmn. and vice-chrmn. respectively of the Public Relations Committee.

C. H. Dexter & Sons, Inc., Windsor Locks, Conn., specialty paper mills, assumed ownership of **Standard Insulation Co.,** East Rutherford, N. J., and will operate it as a wholly owned subsidiary, under the name of **Standard Insulation Co., Inc.**

Standard Insulation specializes in the coating, lamination, and impregnation of glass cloth, paper, fabric, and foil, and also developed a wide variety of resin preimpregnated materials identified as "Stanpreg" for use in aircraft, missiles, electrical laminates and other RP uses.

Lewis C. Kleinhans will continue as Standard's pres. and gen. mgr. The firm will continue operations at its plant and offices in East Rutherford, N. J., and there will be no change in production or sales policies.

R. H. Windsor, Ltd., Chessington, England: **C. Norman Baker** resigned from the boards of **R. H. Windsor, Ltd., Webley & Scott, Ltd., Klaxon, Ltd.,** and **R. H. Windsor (Holdings), Ltd. Peter C. Windsor** appointed to the board of **R. H. Windsor (Holdings), Ltd. R. D. Fox** appointed secy. of all Windsor Group companies.

Arthur G. Dennis is chrmn. and **R. E. G. Windsor** managing dir. of the Windsor Group.

Escambia Chemical Corp.: John B. Clopton named VP and dir. of sales. **Albert E. New** promoted from tech. dir. of the manufacturing div. to VP and dir. of prod. **Dr. W. Mayo Smith** is now VP and dir. of research for the company.

National Automatic Tool Co., Inc., Plastics Machinery Div.: Four States Machinery Co., Chicago, Ill., and Milwaukee, Wis., appointed reps. in the Chicago-Milwaukee area. **Ben Evans,** Natco Plastic's former Midwest mgr., will continue to assist Four States on technical problems.

McIntyre Machine Sales Co. Inc., Worcester, Mass., will represent Natco in New England. **Jim Breese,** Eastern dist. mgr. for Natco will continue to work with McIntyre customers on technical problems.

Wyandotte Chemicals Corp. reorganized its Research and Engineering Div. into two new staff divisions —Research Div. and Engineering and Development Div.

Dr. J. William Zabor, who had headed research of the former combined div., becomes dir. of the Research Div., and **John H. Reifel,** who directed the development activity of the former div., becomes dir. of the Engineering & Development Div.

Commercial Plastics & Supply Corp. has been appointed a distributor in the New York, N. Y., and Newark, N. J., areas for Teflon flexible hose products manufactured by **The American Brass Co.**

Plax Corp.: W. E. Gamron, formerly product mgr., containers, now is sales mgr., industrial and stock containers. **C. N. Sprankle,** previously product mgr. film and sheet, now product mgr. sheet and formed containers. **John W. French,** formerly product development mgr., named product mgr., film.

Hochman Plastics Machinery Corp., Newark, N. J., entered the plastics, rubber, and hydraulic machinery field as suppliers of used, rebuilt, and new equipment. **Herman M. Newman** is pres. The company has offices at 161 Mulberry St., and a warehouse at 79-81 Malvern St., Newark, N. J.

The Electric Storage Battery Co.: Monroe G. Smith, gen. mgr. of **Jessal Plastics Div.,** and **The Industrial Div.,** elected a VP. He will continue to direct the operations of the two divs.

Stokes Molded Products Div.: Matthew Andrews, Andrews & Co., 19015 Van Aken Blvd., Shaker Heights, Ohio, appointed mfr's. rep. for Ohio.

Atlas Powder Co., Wilmington, Del.: **Stanley Arasim, Jr.,** named marketing research mgr. in the product development dept. of the chemicals div.

Arthur F. Quinlan appointed asst. regional mgr. of the chemicals sales office in Chicago, Ill.

Norman Plastics, Inc., 106 E. 19th St., New York 3, N. Y., is a new company which will act as mill rep., distributor, and converter for vinyl film and sheeting. Domestic and imported vinyl from 0.003 to 0.040 gage in a variety of embos- *(To page 217)*

COMPANIES...PEOPLE

(From page 214)

sings, prints, and laminates will be stocked at the company's showroom. **Norman S. Wile,** previously gen. mgr. of Duro-Plast Distributing Co., is pres.

Columbus Coated Fabrics Corp., Columbus, Ohio, formed a Vinyl Metal Products Div. to merchandise vinyl sheeting for lamination to all types of metals. **Edward L. Mahoney,** previously in charge of industrial sales in the New York, N. Y., office, named dir. of sales of the new div.

A. Schulman, Inc., custom extruders and plastics processors opened a branch office at 2947-51 W. Touhy Ave., Chicago, Ill. **James Steiner,** previously asst. sales mgr. of the New York office, named sales mgr., Chicago.

Whittaker, Clark & Daniels, Inc., suppliers of abrasive materials, and manufacturers of stearates and fillers moved New York, N. Y., office to 100 Church St., New York City.

Flexonics Corp., established **Flexonics Research Laboratories** as a new div., located at the company's research and development center, Elgin, Ill. **D. Wendell Fentress,** VP—research and development, assigned responsibility for the new div.

Isochem Resins Corp., Providence, R. I.: **Herbert Schwartz,** Briarcliffe Manor, N. Y., named resident sales engineer.

Mechelec Sales Co., Medford, N. J., appointed sales rep. in the Mid-Atlantic territory.

Plastics Horizons, Inc., Paterson, N. J.: **Vincent W. Costellano,** formerly asst. sales mgr. with Chester Packaging Products Co., appointed salesman to handle polyethylene tubing, folded film, and flat film for packaging.

Raritan Plastics, Inc.: Fred Moesinger, Jr. named plant supt. of the div.

J. R. Ransom, Regional Engineering & Sales Co., 4029-142nd S. E., Bellevue, Wash., named rep. for **Hastings Plastics, Inc.,** Santa Monica, Calif.

Jos. R. Wagner, pres., **Automatic Molding Machine Co.,** subsidiary of **Wagner Bros. Inc.,** sold his interests in the plating supply and equipment field, and has relocated to the company's headquarters at 2231 South Butler Ave., West Los Angeles 64, Calif.

Wallace J. Feasler appointed sales mgr. of **Molded Fiber Glass Co.,** Ashtabula, Ohio.

William Weston elected VP-operations, of **Ultra Chemical Works, Inc.,** a div. of **Witco Chemical Co., Inc.** He will be responsible for manufacturing operations at all company plants.

Robert D. Scott named VP—development, **B. F. Goodrich Chemical Co.,** succeeding **Harry B. Warner.**

E. Duer Reeves elected Exec. VP, a dir., and vice chrmn. of the exec. committee, **Esso Standard Oil Co.** He was previously VP.

Daniel W. Kallman appointed new products mgr., **Aceto Chemical Co., Inc.,** Flushing, N. Y.

Rudolfo Futran G., Importacion Y Tecnica, Av. Mexico Num. 117, Loc. B, Mexico 11, D. F., named exclusive agent in Mexico for **Modern Plastic Machinery Corp.,** Lodi, N. J.

W. A. Maslen resigned from The Projectile & Engineering Co., Ltd., England, to become asst. to **Edwin G. Fisher,** consulting engineer, 4 Palace Ct., Bayswater Rd., London, W. 2, England.

Hubert G. Guy named tech. dir. of Coatings in the Marketing Dept., Plastics Div., **Koppers Co., Inc.**

Bob Coddington joined **Hartig Extruders, Div. of Midland-Ross Corp.,** as Midwest dist. sales mgr.

John J. Leahy, Jr. appointed operating mgr. in charge of the converting depts. by **Tee-Pak, Inc.,** Danville, Ill. manufacturers of cellulose casings and plastics packaging materials for consumer products.

Robert F. McClellan named VP and gen. sales mgr. of the Industrial Div., **Nopco Chemical Co.,** Newark, N. J.

Edward B. Davis, P. O. Box 175, Highland Park, Ill., named Midwest rep., by **Facile Corp.,** makers of Facilon, nylon reinforced vinyl fabric.

Walter H. Hindle, formerly dir. applications research, Chemstrand Corp., joined **Air Reduction Co., Inc.,** as consultant on polyvinyl alcohol fiber.

Carl J. Tylka named dir. of tech. service for **Cooper Alloy Corp.,** Hillside, N. J., manufacturers of valves, fittings, pumps and castings.

Raymond H. Marks promoted from sales mgr. to VP—sales of **Cary Chemicals, Inc.,** East Brunswick, N. J. He replaces **Thomas Zawadzki,** now VP—product development.

De Witt S. Stillman, Jr., formerly with The Dow Chemical Co.'s market research staff, appointed an adm. asst. to **W. B. Sander,** pres. of **Extruders, Inc.,** Hawthorne, Calif., a supplier of polyethylene film. Extruders is a Dow subsidiary.

Merritt L. Smith appointed dir. of advertising & publicity for **Metal & Thermit Corp.,** Rahway, N. J., manufacturers of vinyl stabilizers.

Jack G. Fuller, previously with Hercules Powder Co., appointed sales mgr. for **Chemtrol,** Lynwood, Calif., manufacturers of corrosion-service plastics piping systems equipment.

Harold G. Kilb joined the recently established Chemical Div., **Bostrom Corp.,** Milwaukee, Wis., to handle promotion and sales of the company's Permathane molded urethane foam products in the aircraft, automotive, home and office furniture, and packaging markets.

Dr. Carl E. Barnes, formerly dir. of central research, elected VP—research by **Minnesota Mining & Mfg. Co.** He is succeeded by **Dr. John W. Copenhaver.**

Kenneth H. Beer named mgr.—**Consolite Div., Consolidated General Products, Inc.,** Houston, Texas. He will be in charge of development and distribution of Consolite reinforced plastics skylights.

Dr. Games Slayter, VP—research and development, **Owens-Corning Fiberglas Corp.,** Newark, Ohio, received the 1959 Toledo Glass and Ceramic Award.

Corrections

MODERN PLASTICS *Encyclopedia Issue 1959:* **Atlas Vac-Machine Corp.,** 1732 Hudson Ave., Rochester 6, N. Y., should be listed in the Directory Section as a manufacturer of sheet forming machines on page 1114.

Isochem Resins Corp., 221 Oak St., Providence 9, R. I., should be listed as a manufacturer of color dispersions in resins and plasticizers on page 1095.

"When you want polyethylene, know what you want" (MPL, Oct. 1958, p. 87): European-made drum shown in photograph was produced by Alfred Fischbach, Ründeroth, Bez. Köln, West Germany.

"Why RP battery hoods?" MPL, Nov. 1958, p. 169): Fiber Glass Products Div. of Bigelow-Sanford Carpet Co., Inc., credited with fibrous glass reinforcing mat for the hood, was acquired by Fiber Glass Industries, Inc., Amsterdam, N. Y. The Bigelow name is no longer associated with fibrous glass products.

"S.P.E. technical conference" MPL, Dec. 1958, p. 128). Paper entitled "Relationship of Molecular Structure to Electrical Characteristics" will be given during Session 7 by Dr. Charles Phelps Smyth, Frick Chem. Lab., Princeton University.—END

CLASSIFIED ADVERTISEMENTS

EMPLOYMENT • BUSINESS OPPORTUNITIES • USED OR RESALE EQUIPMENT

Machinery and Equipment for sale

FOR SALE: Banbury #1, 00, Midget, 3A Baker Perkins 150 gal. 2 Arm S.S. 40 HP Jacketed Vacuum Hyd Tilt, 100 gal. 2 Arm 50 HP. Calenders 3 Roll 45"x18 6 Roll 12"x5, 1000 Ton Hobbing Press Stokes 3 DDS2, 1 T, 2 DS3, 1 B. Ball Mills. Powder Blenders. Hydr. Pumps. Machinecraft Corp., 800 Wilson Ave., Newark 5, N. J. Mi 2-7634.

FOR SALE: Unused Ingersoll-Rand High Pressure Air Compressor, displacement 8CFM at 3000 PSI. Compressor furnished with or without motor and drive. Ideally suited for charging and maintaining air charge in Air Bottle Accumulator Systems. Will sell at less than ½ original cost. Reply Box 5215, Modern Plastics.

FOR SALE: One 1946 Model Reed Prentice 8 oz. Double Toggle—Welded Frame —rebuilt 1958. One 1946 Model Reed 24 oz. One 1945 Model Watson 22 oz. 480 Ton Clamp 30 inch Daylight. Including extra 12 oz. High Pressure Cylinder. All machines include instruments. All machines in operation. Reply Box 5213, Modern Plastics.

EXCELLENT: 400 ton W/S Hyd. Press 7 platens—24 x 56—20" stroke, 26½" daylight—2, 16" rams, 5 h.p. Vickers low pressure and 2 stage high pressure pumps, $5,000. Sheeting Line: 4½" Hartig 20/1 48" Robbins Take Off. Less than 2 yrs. old. Excellent Condition. 42" die. 50 h.p. Reliance Drive automatic shear, $25,000. Both above can be seen operating. B. J. Danson & Assoc. Ltd., 1912 Avenue Road, Toronto.

FOR SALE: Two De Mattia 6 oz. Injection Molders, factory rebuilt this year. Reed Prentice 10D8 New 1952, 8 oz. Cap. All machines can be seen in use. Garden State Machinery, 442 Frelinghuysen Avenue, Newark, N.J.

FOR SALE: 1 Baker Perkins Mixer, 100 gal. working cap., size 15, fully jacketed, cored sigma blades, screw power tilt, chain motor drive. 1 Thropp Mill, 18" x 48", heavy duty, top cap frame, 100 h.p. motor drive. 2 Robinson Ribbon Blenders, 3000 & 6000 lbs. cap., geared-head motor drives. 1 SS Ribbon Blender, 600 lbs. cap. 2 Paterson Ball Mills, Jacketed, 6'x5'&5'x5', steel lined, AC motor drives. 1 N.R.M. Extruder, 3½", 20-1 ratio, elect.—oil heated, variable speed drive. 1 Royle #2 Extruder, Vbelt Motor drive. Hydraulic Presses. Lab. Mills & Calenders. Stokes & Colton Tablet Presses. Grinders & Screens. Kahn Equipment Co., 1650 Coney Island Ave. B'klyn 30, N.Y. Tel: DEwey 6-4640.

FOR SALE: Vinyl Molding Equipment. 2-complete rotation and slush molding set-ups. Reply Box 5200, Modern Plastics.

FOR SALE: Natco A-33A comb. Hand & Foot & Air Oil Feed Machine for drilling and tapping. (1947) 10¾" dia. spindles ¼" drill & tap cap. Drilling area of head 5¼"x9¾", working table 9"x12"; Feed travel table 4" hgt. 70", Wgt. 800 lbs. 8 speeds. Harry Davies Molding Co., 1428 N. Wells Street, Chicago, Ill. MI2-7240.

FOR SALE: Gas fired heater, 250,000 BTU, and drying oven 250° F., exhaust and recirculating blower system with all electric and safety controls. Kuhmarker Waxed Paper Co., Inc., 185 Sumner Avenue, B'klyn 21, N.Y., GLenmore 3-2186.

FOR SALE: Banbury Mixers—Model #3 with 75 hp M.D., Model #3A, see in operation. 350 ton transfer molding presses, 24" x 24" bed, top transfer cylinder. Reed-Prentice 8 oz. double link machines, late. Terms available. We will finance. Johnson Machinery Co., 679-P Frelinghuysen Ave., Newark, N.J. BIgelow 8-2500.

FOR SALE: 35—Baker-Perkins #17, 200 gal. jacketed sigma blade Mixers. Some units with individual 30 HP motors, drives and screw tilts. Others with counterweight tilts. Prices are cheaper than ever before—They Must All Go. Phone or wire for details. Perry Equipment Corp., 1429 N. 6th Street, Philadelphia 22, Pa.

JUST SECURED—Most Modern Packaging and Processing Machinery—Available at Great Savings. Hayssen Model F Compaks with net weight scales, bulk and dribble feeds, Electric Eyes. Ceco Model 40-9½-GG Automatic Adjustable Cartoning Units. Also Model TT. Package Machinery, Hayssen, Scandia, Wrap King, Miller Wrappers. Pneumatic Scale Automatic Carton Feeder, Bottom Sealer, Wax Liner, Top Sealer with interconnecting Conveyors. Pneumatic Scale Tite Wrap. Fitzpatrick Model D-6 Stainless Steel Comminuters. Day, Robinson 50 to 10,000 lb. Dry Powder Mixers. Werner & Pfleiderer 3,000 gal. and 3,500 gal. Jacketed Double Arm Mixers. Baker Perkins, from 2 to 100 gal., Double Arm Mixers, Jacketed and Stainless Steel. Stokes DD2 and Eureka Tablet Machines. Complete Details and Quotations Promptly Submitted. Union Standard Equipment Company, 318-322 Lafayette Street, New York 12, N.Y. Phone: CAnal 6-5334.

FOR SALE: Two 15 Ton Stokes Automatic Compression Molding presses. Model 200-D-2, purchased new in 1940. Excellent operating condition. $500.00 each for quick sale. Rogan Bros., 8025 N. Monticello Ave., Skokie, Illinois. Phone: ORchard 5-1233.

FOR SALE: Calender—Farrel 2-roll, 10" x 17". Extruders—NRM 1½", complete plastic wire coating unit; NRM 2" saran; Royle 3¼", 15 HP vari-drive; Adamson 8". Injection Machines—Watson-Stillman 4 oz. Vertical; Reed-Prentice 6 oz. and 16 oz., Impco 22 oz. Hydraulic Presses—Stokes 15 ton, Model ZOOD-3, full automatic; Loomis & Francis 40 ton, multi-opening; Baldwin-Southwark 75 ton; Watson-Stillman 75 ton, semi-auto., self-contained (2); Watson-Stillman & HPM 100 ton; Elmes 200 ton; Watson-Stillman 400 ton; Farrel 625 ton. Preheaters—G.E. 1.5 and 5 K.W. Pelletizers, Rotary Scrap Cutters, Mills, Mixers, Banburys, Boilers, Machine Tools, etc. Hochman Plastics Machinery Corporation, 151-P Mulberry St., Newark, N.J. MItchell 3-8430

FOR SALE: 1—Hartig 3¼" electrically heated plastics extruder; 4 compression molding presses, 470, 200, 100 and 40 tons; 1 Abbe #2 rotary cutter, 25 HP; 2 Cumberland granulators, #0, #½, 3 HP; 1 Royle 10" strainer, 150 HP; also mills, mixers, presses, etc. Chemical & Process Machinery Corp., 52 9th Street, Brooklyn 15, N.Y., Phone HY 9-7200.

FOR SALE: 2 oz. Van Dorn semi auto. 4 oz. Lewis, 1954—$3,000. 4/6 oz. R-P, 1955. 4 oz. vert. DeMattia. 8 oz. R-P, 1946—$5,000. 12 oz. W-S Model E—$6,000. 12 oz. Lester w/solid frame—$4,000. 16 oz. vert. Impco. 48 oz. W-S 1950. Two head bottle blowing machines. Ovens, grinders, powder mixers, injection molding machines 1 oz. to 60 ozs. never used and used. Acme Machinery & Mfg. Co., Inc. 20 South Broadway, Yonkers, N.Y. YOnkers 5-0900. 102 Grove Street, Worcester, Mass. PLeasant 7-7747. 5222 W. North Ave., Chicago, Illinois, TUxedo 9-1328.

FOR SALE: 1000 ton and 2000 ton hydraulic presses—1 oz. model H-200 Van Dorn injection machine—3 oz. Fellows, 8 and 12 oz. Lesters, 50 oz. Impco—400 ton 36"x36" vertical presses—No. ½ and 1½ Ball and Jewell grinders—Carver laboratory presses and others to 75 ton—6"x13" laboratory mills—Plastic Machinery Exchange, 426 Essex Avenue, Boonton, N.J., phone DE 4-1615—Cable address Plasmex-Boonton.

FOR SALE: 5—Thropp 20"x22"x60" two roll Mills with Falk reducers and 125 HP motors; 5—Baker Perkins size 15 JIM2, 100 gal. steam jacketed double arm Mixers; 1—Baker Perkins size 16 TRM, 150 gal. double arm Mixer; 1—Ball & Jewell #1 Rotary Cutter; 1—Kent 6"x14" three roll Mill; 6—Stokes Model DD2, DS3, D3 and B2 Rotary Preform Presses; 4—Stokes Model "R" single punch Preform Presses. Also: Sifters, Banbury Mixers, Powder Mixers, etc., partial listing; write for details; we purchase your surplus equipment; Brill Equipment Co., 2407 Third Ave., New York 51, N.Y.

FOR SALE: H.P.M. Rubber Injection molders, 21½"x28" mold space, steam heated platens. Watson-Stillman 300 ton semi-automatic compression molding press (1947) self-contained mold size 34"x27". Watson-Stillman 250 ton 28"x24". Watson-Stillman 140 ton 22"x16". Waterbury Farrel 85 ton 20"x24". W.F. 63 ton 15"x15". Laboratory presses—15 ton 10"x 8" and 10 ton 6"x6" platens. (2) 8 ounce Reed Prentice injection molding machines and (1) 8 ounce Lester Phoenix (late) with nylon attachment. Scrap cutters, valves, accumulators. Hydraulic Presses—all sizes. Aaron Machinery Co. Inc., 45 Crosby St., New York, N.Y. Tel.: WAlker 5-8300.

FOR SALE: Baldwin-Southwark 200 ton semi-automatic transfer molding press. 2500 ton downstroke 54" 102". French Oil 250 ton 38"x28". 200 ton hobbing press. 200 ton 16" record presses. D & B 140 ton 36"x36". French Oil 120 ton self-contained. W. S. 120 ton 24"x24". Hydraulic pumps and accumulators. Van Dorn 1 and 2 ounce injection machines. Lester 16 oz. complete. Other sizes to 100 oz. Baker-Perkins and Day jacketed mixers. Plastic cutters. Oxford 57" slitter. Seco 6"x13" and 8"x16" mills and calenders. Adamson 6" rubber extruder. Oil and Elect. Plastic extruders, lab to 6". Single & Rotary preform press ½" to 4". Partial listing. We buy your surplus machinery. Stein Equipment Co., 107—8th St., Brooklyn 15, N.Y.

FIRST CLASS EQUIPMENT from Your First Source. A Battery of Unused Farrel Birmingham Modern Top Cap Design Rubber or Plastic Mills 14"x30" each with UNI Drive; also on sale FB 42" and 60" Mills; Multi Platen Hydr. Presses 24"x56"; 10" Rams; 3000 PSI; Baker Perkins Hvy Duty Jktd. Mixers; 100, 200, 300 gal.; Battery of Hydr. Sheeters; 26" Seybold 63" Rubber Cutter; Utility Stock Cutter compl. Ball & Jewell S/S Rot Cutter; Erie Jktd. Extruder; 6"x66" Tablet Presses by Stokes, Colton, Kux; Single & Rot. Send for Latest Issue of "First Facts". First Machinery Corp., 289-10th St., Bklyn. 15, N.Y., STerling 8-4672; Cable; Effemcy.

FOR SALE: 36" Mill, 200 ton Molding Press, Ball Mills, Sifters, Extruder, Banbury Mixer, Calender, Dicer, Granulators, B-P Mixer, 15 HP Boiler. Unimax Corp., 8200 Bessemer Ave., Cleveland, O.

(Continued on page 220)

FOR SALE: Two sixteen ounce Watson-Stillman Injection Molding Machines, 1954 and 1949 Models. Both machines in Excellent Condition and may be seen operating. Continental Plastics Corp., 108 N. E. 48th Street, Oklahoma City, Oklahoma.

Machinery wanted

WANTED TO BUY: Two bench Model Preheaters—Approx. 400-500 Watt rated Output. Wm. J. Murdock Co., 158 Carter Street, Chelsea, Mass.

WANTED TO BUY: Used injection molding machines, oven, granulators. One machine or complete plant. Acme Machinery & Mfg. Co. Inc., 20 South Broadway, Yonkers, N.Y. YOnkers 5-0900. 102 Grove Street, Worcester, Mass., PLeasant 7-7747. 5222 West North St., Chicago, Illinois. TUxedo 9-1328.

WANTED: 6"x13" Laboratory 2-roll mill in good condition. Rolls cored for heating and chrome plated. Ratio around 1.4:1. Write: Industrial Vinyls, Inc., 5511 N.W. 37th Avenue, Miami, Florida.

WANTED: One Rotary cutter to granulate a 30" wide continuous Vinyl ribbon. Reply Box 5207, Modern Plastics.

PLASTIC DRYING OVEN, electrically heated, capacity 24 to 40 trays. Reply Box 5201, Modern Plastics.

Materials for sale

FOR SALE—Vir. and Rep. Styrene, G.P.-M.I.-H.I. Crystal—Natural—Colors—Tinsels—Pearls. Erie Plastics, 1223 Walnut St., Erie, Pa.

FOR SALE: Ethocel 610 clear plastic sheeting in unopened crates. 39 rolls 30" x 3,000' x .003 in. thick. Excellent condition. $75.00 per roll. Will pay one-half shipping charges anywhere in U.S. John Dreyer, Jr., 9854 Zig Zag Road, Cincinnati 42, Ohio.

FOR SALE: 50,000 lbs. Virg. black Polyethylene extrusion grade. 30,000 lbs. Virg. natural with black Polyethylene. 23,000 lbs. Virg. natural linear Polyethylene, 0.7 melt and 5.0 melt. 10,000 lbs. black linear pellets. Also standard toy colors linear Polyethylene reprocessed or reground. Low prices. Reply Box 5222, Modern Plastics.

FOR SALE—Virg. and Reproc. Polyethylene, Natural—Colors—Tinsels—Pearls. Erie Plastics, 1223 Walnut St., Erie, Pa.

Materials wanted

WANTED: All types of plastic scrap and surplus inventories such as: styrenes, butyrates; acetates, acrylics and polyethylenes in any form. Write, Wire or Phone Collect, Humboldt 1811. Philip Shuman & Sons, 15-33 Goethe Street, Buffalo 6, New York.

MOLDERS—FABRICATORS—VACUUM FORMERS: Please contact us for best evaluation when liquidating your year-end inventory of Plastic Scrap and Excess Inventory. Claude P. Bamberger, Inc., One Mount Vernon Street, Ridgefield Park, N.J., Telephone: Hubbard 9-5330.

WANTED: Interested in Buying Engraved Embossing rolls, 60" face, Good Condition, discontinued patterns. Please give journal dimensions and prices. Reply Box 413, Hudson Falls, New York.

WANTED: Plastic of all kinds—virgin, reground, lumps, sheet and reject parts. Highest prices paid for Styrene, Polyethylene, Acetate, Nylon, Vinyl, etc. We can also supply virgin & reground materials at tremendous savings. Address your inquiries to: Gold-Mark Plastics Compounds, Inc., 4-05 26th Ave., Long Island City 2, N. Y. RAvenswood 1-0880.

WANTED: Vinyl and Polyethylene Scrap. Send description and small sample. We are continuous buyers. American Vinyl Corp., 73-30 Grand Ave., Maspeth 78, N.Y. Tel: DEfender 5-9200.

Molds for sale

FOR SALE: Houseware molds, comb molds, also some novelty and specialty items. All in excellent condition. No reasonable offer refused. Send for list. Reply Box 5220, Modern Plastics.

FOR SALE: Boat Program. Four hull molds; four deck molds; jigs, patterns, fixtures; architect's drawings, etc. Greatly reduced package price. Boat is 15'6" runabout. Howard Chapelle design. Reply Box 5210, Modern Plastics.

Molds wanted

MOLDS WANTED: For Poker Chip Racks, Buttons, Novelties, Houseware Items, Foreign Or Domestic. Ludonite Corp., 88 St. Francis Street, Newark 5, N.J.

Help wanted

EXTRUSION ENGINEER familiar with practical phases of PVC extrusion, compounding, and set up new extrusion division for flexible tubing. Location New York City. Reply Box 5231, Modern Plastics.

CHIEF ENGINEER—Injection Molding Plant, Complete Charge Tooling, Estimating, Methods and Automation. Wonderful opportunity Right Man—Fringe Benefits—Salary open—Metropolitan Area. Reply Box 5230, Modern Plastics.

MANUFACTURERS AGENTS WANTED: to handle premix compression molded parts from polyester molding compounds. AAA-1 firm has design, tooling and production know-how plus capacity. Interested in agents now selling parts, stampings, etc., to OEM and Allied industrial accounts. Commission basis. Leads furnished. Choice territories open. Reply Box 5225, Modern Plastics.

PLASTICS ENGINEER: Small plastics company in New York area has opening for Mechanical Engineer with a few years experience in plastics molding field. Duties include mold design and process development work in molding and casting fields. Excellent opportunity for young creative man to grow with growing company. Send resume. Box 5224, Modern Plastics.

SALES ENGINEER—PLASTICS: Long established, nationally known, expanding midwest custom molding firm with exceptional facilities in both thermoplastics and thermosetting, has an immediate opening on sales staff for an alert and aggressive individual. Should have a proven record of successful technical sales background and a thorough knowledge of compression and injection molding. Territory will be in the Chicago area. Your response will be held in strict confidence. Submit resume giving full details on background, experience, education, salary expected. Reply Box 5214, Modern Plastics.

CHEMIST-CHEMICAL ENGINEER: With experience in development of Vinyl & Polymers, to head new section of expanding plant in Metropolitan N.Y. Reply Box MP 895, 125 West 41st St., N.Y.C.

ELECTRICAL ENGINEER: Manufacturer of nationally known line of Epoxy Plastic Compounds needs Electrical Engineer or man with equivalent experience. Duties will entail field technical sales as well as some administrative work in the home office. Some experience with plastics would be helpful. This is a real opportunity with an excellent salary plus a profit sharing bonus. Reply Box 5212, Modern Plastics.

WANTED: Experienced set-up man who knows how to get quality work from Injection Molding Machines. Plant located in Tennessee. Reply Box 5208, Modern Plastics, stating experience, family status, present income. New plant, good opportunity for right man.

INJECTION MOLD ENGINEERS: Attractive opening in molding plant for qualified engineers, experienced in the design and development of molds and fixtures for high volume production of acrylics, nylons and cellulosics. Applicant should be a graduate engineer or equivalent with several years of experience in this field. Excellent opportunity for advancement. Send resume to: Ford Motor Company, Salaried Personnel, P.O. Box 412, Ypsilanti, Michigan.

DRAFTSMAN with experience in plastic mold design department, willing to familiarize himself with all phases of custom molding. All replies held in strict confidence. Reply Box 5202, Modern Plastics.

HELP WANTED: Large Southwest molder of plastics has openings for thoroughly experienced supervisory men. Background should include operation of Watson-Stillman and H.P.M. presses in capacities of 200 ounces and above. Should be able to lead men and handle floorwork. Write complete work history, showing education and previous work history for last 10 years to Box 5219, Modern Plastics. Please state minimum starting wage.

WANTED: Vinyl Chemist For Technical Service. Progressive chemical company in northern New Jersey metropolitan area offers a rare career opportunity for a man with extensive experience and following in the vinyl-processing field. Position includes laboratory work—testing plasticizers for both vinyl and floor tile industries. Experience in vinyl compounding necessary. Customer contact involved. Salary commensurate with abilities and potential. Send detailed resume. Reply Box 5211, Modern Plastics.

FLOORING CHEMIST: Leading flooring manufacturer desires man with experience in rubber or vinyl flooring. Excellent opportunity in development and production. Salary commensurate with experience. Replies confidential. American Biltrite Rubber Co., Trenton 2, N.J., Attn: Mr. M. Smith.

FOREMAN: to run Liberty Plastic Laminating and Embossing Machinery. Located in greater Boston Area. Experience in laminating vinyl to fabric, paper and vinyl desired. Excellent salary and unusual opportunity. Write full particulars in confidence. Reply Box 5232, Modern Plastics.

MANUFACTURERS AGENTS to represent a progressive molder of custom molded fiberglass reinforced plastics and custom vacuum formed sheet. Choice territories open including Michigan, Indiana, Southern Ohio, Western Pennsylvania, and Western New York. Reply to P. O. Box 857, Cleveland 22, Ohio, giving full particulars.

MOLD MAKER—PLASTIC: Must be thoroughly familiar with estimating, designing and capable of supervising 10-15 man shop including apprentice training. For right man this is an opportunity to become partner without investment. Location central Long Island. Send complete resume of experience, salary expected. All replies confidential. Reply Box 5206, Modern Plastics.

COATINGS CHEMIST: Experienced in application of plastic coating to fabrics, films, and papers. Company operates modern coating plant processing vinyls for use in well established line of plastic products. We need an experienced man to take charge of developmental program to integrate new products with our present and expanding plastic business. Location midwest. Reply Box 5203, Modern Plastics.

WANTED—MFG. AGENT: A competent high caliber man with good connections throughout the country with pharmaceutical mfgs. Holding exclusive world patent designs in the rapid growing field of disposable plastic syringes. Medical and veterinary application. High commissions—exclusive U.S. territory. Part time acceptable. Reply Box 5204, Modern Plastics.

PLASTIC PIPE SALES MANAGER: Amply financed South Atlantic manufacturer, just building PVC extruded pipe plant, seeks Ch.E. Graduate to develop sales and sales promotion. Must have substantial background in plastics, know jobbing channels, and have proven record in sales management. Replies should include full detail of education, work record, earnings, availability. Wally E. George, Management Consultant, 425 Cherry, S.E., Grand Rapids 2, Mich.

POLYETHYLENE SALESMAN: Spencer Chemical Company seeks a man with enthusiasm, drive and a desire for future progress in a plastics sales assignment. Previous sales experience desirable. Technical background also preferable but not necessary. Excellent opportunity for future advancement in a rapidly expanding organization. Please send resume of your experience, education, and salary requirements to: Field Sales Manager, Plastics Division, Spencer Chemical Company, 1004 Baltimore, Kansas City, Missouri.

TOOL DESIGNER: Well-established, growing proprietary molder is seeking man experienced in injection mold design. Knowledge of modern molding equipment and plant engineering desirable. Excellent permanent position. Plant located in New York Metropolitan area. Send complete resume with salary requirements to Box 5221, Modern Plastics.

PERSONNEL: Executive—Technical—Sale—Production. Employers and Applicants—whatever your requirements, choose the Leader in Personnel Placement. Cadillac Associates, Inc., Clem Easly—Consultant to Plastics Industry, 220 South State, Chicago 4, Ill—Wabash 2-4800. Call, write or wire—in confidence.

Situations wanted

POLYESTER CHEMIST: 30, single, with good laboratory and shop experience in polyester and some background in urethane foams, desires Chemical, Technical or Supervisory position in chemical or reinforced plastics industry. Reply Box 5209, Modern Plastics.

EXTRUSION PRODUCTION MANAGER: Capable, aggressive, with twelve years experience in all phases of plant management. Excellent knowledge of tool, machine, and die design. Good mechanical and electrical background. Experienced in tubing, pipe, sections, sheet, and custom work in thermoplastics. Seeking responsible position with aggressive firm. Reply Box 5223, Modern Plastics.

PRODUCTION SUPERVISOR: Seven years experience in reinforced plastics and other diversified fields. Mechanical engineer with varied background in production scheduling, methods specification, inventory control, testing and inspection, product development and machine shop practice. Desire work in small or medium size molding firm within fifty miles of New York. Detailed resume available. Reply Box 5228, Modern Plastics.

LONG PRACTICAL AND MANAGERIAL BACKGROUND Design Production and Sales Industrial and Consumer Thermoplastic Products, extensive and thorough experience RF sealing with national concerns, seeks new connection at active top level all phases. Equity ownership or stock option considered. Unquestionable references. Reply Box 5229, Modern Plastics.

DETROIT AREA manufacturers' representative wants sources on compression and injection molding. Can give you energetic coverage of industrial area of Michigan. Especially interested in phenolic compression and nylon injection moldings. Reply Box 5218, Modern Plastics.

CHIEF CHEMIST VINYL BS, MS, CHEM ENGR: 9 Years experience in development, application, control of vinyl plastisols, organosols, solutions, latices. Broad knowledge of materials, methods, testing. Includes both coating and rotocasting. Aggressive, responsible, inventive. Demonstrated supervisory and administrative abilities. Desires position as Chief Chemist, Tech Director or Superintendent. Reply Box 5226, Modern Plastics.

MANUFACTURER'S REPRESENTATIVE—Presently handling one line; can devote time and energy to additional established line in the Chicago area. Twenty years experience industrial and packaging fields; creative selling ability plus mechanical aptitude, combined with honest conscientious coverage and the will to work and build for future volume sales. Try me. Reply Box 5227, Modern Plastics.

CONSULTANT SERVICES on Kel-F plastics available—extrusion, injection and compression molding, coatings, heat sealing, and vacuum forming. Specialized experience in wire coating, film, tubing, compression sheet and slugs. Package fabrication services and facilities. Mold and die design. Reply Box 5205, Modern Plastics.

LINES WANTED: Manufacturers' Representative, twenty-five years experience has openings for plastic baby items, toys, novelties, staples. Selling to variety chains, drug, toy, notions, household, and baby jobbers. Can furnish New York sales office, show rooms. Commission basis. Can arrange packaging where necessary. Reply P.O. Box 157, Madison Square Station, New York 10, N.Y.

Business opportunities

BUSINESS WANTED
Successful Plastic Business Executive in sales and administration, interested in acquiring another plastic firm in injection, extrusion, Fiberglas or drape vacuum forming. Present management must agree to stay on for reasonable length of time. State full particulars. Reply Box 5217, Modern Plastics.

WILL PURCHASE: Operating plant with substantial capacity or going company manufacturing Plastic Coated Wire or Cables. Eastern location preferred. Confidential preliminaries will not be disclosed to our client. W. M. Grosvenor Laboratories, Inc., 50 East 41st Street, New York 17, N.Y., MUrray Hill 3-4898.

Miscellaneous

FOR SALE: Dies, hobs & marketing equipment for family of 5 miniature vinyl plastic jointed doll house dolls. Exquisitely detailed, wonderful promotional opportunities. Illness forces sale at fraction of original cost. Royalty basis also considered. Write for details: Mountain View Photo Finishers, C. E. Moeller, 431 E. Girard, Englewood, Colo.

WANTED: Used 24" or larger, Grinder for thin high impact sheet. Write giving complete specifications. Mold for sale—2 cavity 10" windshield scraper, good condition. Reply Box 5216, Modern Plastics.

All classified advertisements payable in advance of publications

Closing date: 10th of preceding month, e.g., January 10th for February issue
Per inch (or fraction) ....$20.00; each 3 inches or fraction (in border) $10.00 extra
For purpose of establishing rate, figure approximately 50-55 words per inch.
For further information address Classified Advertising Department
Modern Plastics, 575 Madison Avenue, N. Y. 22, N. Y.
Modern Plastics reserves the right to accept, reject or censor classified copy.

Note: Beginning with the March issue, the following rate schedule becomes effective:
Per inch (or fraction) $30.00
Each 3 inches or fraction (in a border) .... $15.00 extra
Situations Wanted ads .... 1/3 of above rates

INDEX OF ADVERTISERS

Distribution of this issue: 33,700

MODERN PLASTICS

PUBLISHED BY BRESKIN PUBLICATIONS INC. 575 Madison Avenue, New York 22, N. Y.

EDITORIAL

Standards are everybody's business

In a speech before the 9th National Conference on Standards, Alfred C. Webber of Du Pont's Polychemicals Dept., Chairman of Committee E-1, Vice-Chairman of Committee D-20 A.S.T.M., and a member of the U. S. delegation to the International Standards Organization Technical Committee 61 on Plastics made some cogent remarks concerning molder and end-user participation in standards committee work.

Here we have an industry that in 1938 produced 11 different materials in a quantity of 150 million pounds, and in 1958 produced 29 main types of materials in a quantity of 4.4 billion pounds. With approximately 180 producers of raw materials that become plastics, with nearly 3000 processors—both captive and custom—the matter of specification is of primary importance, particularly since the trend is toward combining materials in plastics alloys and copolymers.

A.S.T.M. has firm rules as to the composition of specification committees. No committee of less than six men can write a specification for any material. In each committee at least half of the personnel must be consumers—molders, end-users, etc., plus general-interest people such as university staff members. The rest of such a committee may be representatives from material-making concerns.

An individual membership in A.S.T.M. costs $18.00, a company membership $75.00. This, in our opinion, is a bargain. Yet committee chairmen have a continuing problem in getting molder and end-user participation in this important work.

We now have 125 established test methods and 44 specifications for plastics in the United States. Internationally, through I.S.O., 29 standards have been adopted by the Committee and six more are ready for balloting. Agreement has been reached on 800 specific terms in six languages.

The savings and promotion of increased business to be obtained through plastics standards are many. Inventories will be less heterogenous. Premium prices should be obtained for quality above industry tolerance specifications. Communications between production management, sales management, and the customer will be made easier. The invasion of new fields, such as the construction field, by plastics will be speeded up.

In the interests of better business we again urge all plastics processors to join in this work.

Chairman of the board
Charles A. Breskin

President and publisher
Alan S. Cole

Editor
Hiram McCann

Managing editor
Sidney Gross
Frank Murray, *assistant*

Senior editors
R. L. Van Boskirk
A. Paul Peck

Technical editor
Dr. Gordon M. Kline

Engineering editor
Dr. James F. Carley

Features editor
Joel Frados

Associate editors
Alfred M. Cappiello
Guy Bishop

Midwestern editor
Val Wright

Readers service
Eve H. Marcus

Art director
Donald R. Ruther

Production
Daniel M. Broads, *director*
Bernard J. Farina
Jack M. Postelnek

Treasurer
Beatrice Grove

Circulation
Robert B. Birnbaum, *director*
George Leiz, *subscription mgr.*

Promotion
Philip W. Muller, *manager*

Business staff
New York 22, 575 Madison Ave.
Tel., PLaza 9-2710
S. S. Siegel, *manager*
M. A. Olsen
P. H. Backstrom
B. W. Gussow
R. C. Nilson
B. R. Stanton

Chicago 11, 101 E. Ontario St.
Tel., DElaware 7-0060
J. M. Connors, *vice-president*
W. F. Kennedy
H. R. Friedman

Cleveland 20, 3537 Lee Rd.
Tel., SKyline 1-6200
R. C. Beggs

Los Angeles 48, 6535 Wilshire Blvd.
Tel., OLive 3-3223
J. C. Galloway

London E. C. 4, England
29 New Bridge St.
Tel., CITy 3049
T. G. Rowden

Frankfurt am Main, Germany
Wittelsbacher Allee 60
Tel., 46 143/46 372
G. J. Linder